The relation between finance utilisation and business performance in Indonesian horticulture

Eliana Wulandari

Thesis committee

Promotor
Prof. Dr A.G.J.M. (Alfons) Oude Lansink
Professor of Business Economics
Wageningen University & Research

Co-promotor
Dr M.P.M. (Miranda) Meuwissen
Associate professor, Business Economics Group
Wageningen University & Research

Other members
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Dr M.M. (Marrit) van den Berg, Wageningen University & Research

This research was conducted under the auspices of the Wageningen School of Social Sciences (WASS)

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Thesis

submitted in fulfilment of the requirements for the degree of doctor
at Wageningen University
by the authority of the Rector Magnificus
Prof. Dr A.P.J. Mol,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Friday 23 December 2016
at 11 a.m. in the Aula.

Eliana Wulandari

The relation between finance utilisation and business performance in Indonesian horticulture
147 pages.

PhD thesis, Wageningen University & Research, Wageningen, NL (2016)
With references, with summary in English

ISBN: 978-94-6343-029-6
DOI: 10.18174/399659

Abstract

Finance is important for Indonesian farmers to purchase agricultural inputs and machinery and to pay for hired labour, which can improve farm performance. Farmers in Indonesia can access finance from various finance providers, i.e. banks, micro-finance institutions, farmers' associations, traders, agricultural input kiosks and so-called "other sources" such as family and friends. The overall objective of this thesis was to analyse the relation between finance utilisation from different finance providers and horticultural business performance in Indonesia. This thesis first compares farmer knowledge of the requirements to obtain finance with the actual requirements set by finance providers, and investigates factors that determine farmer knowledge of the requirements. Next, this thesis analyses the relation between finance utilisation from different finance providers and the technical efficiency of horticultural farms using a bootstrap truncated regression. Furthermore, the role of finance utilisation from different finance providers in production risk is analysed using an ordinary least squares regression. Finally, this thesis analyses finance utilisation and its relation with chili supply chain continuity as reflected by contract fulfilment rates using a censored regression analysis. Findings show that farmers generally have little knowledge of the finance requirements. Findings also show that in-kind finance utilisation from farmers' associations positively associates with farmer knowledge of finance requirements. The results of the bootstrap truncated regression show that commercial credit from banks and in-kind finance from farmers' associations positively associate with the technical efficiency of some types of horticultural farms. Commercial credit from micro-finance institutions and flexible payment of inputs to agricultural input kiosks generally have negative associations, especially with the technical efficiency of mangosteen farms. Subsidised credit from banks and in-kind finance from traders have both positive and negative associations with the technical efficiency of the horticultural farms. With regard to production risk, results show that depending on the risk measure, risk-reducing associations were found for commercial credit from banks and flexible payments of inputs to kiosks. With respect to supply continuity, outcomes show that chili contract fulfilment rates are positively associated with in-kind finance from farmers' associations, but negatively associated with subsidised credit from banks and flexible payment of inputs to agricultural input kiosks.

Keywords: Finance utilisation, horticultural business performance, bootstrap truncated regression, censored regression, ordinary least squares regression

Contents

Chapter 1

General Introduction

1.1 Background

The agricultural sector plays an important role in Indonesia for achieving food security at national, regional and farm household level (Lantarsih 2016). Horticulture has the highest contribution to Indonesian GDP in the agricultural sector. According to data from the Central Bureau of Statistics in Indonesia (BPS 2013), horticulture contributes 40% to GDP of agriculture whereas 3 million people find their employment in this sector.

Agricultural inputs such as seeds, fertilizer and pesticides, machinery, and labour in agriculture are very important for increasing both the quantity and quality of production. In order to have better access to inputs, machinery and labour, farmers need to have finance allowing them to purchase agricultural inputs such as seeds, fertilizers, insecticides and fungicides, to purchase machinery and to pay for hired labour. In recent years, finance for farmers has been a concern for policy makers, especially in developing countries (Ammani 2012; Ugwumba and Omojola 2013). Also, the Indonesian government has established policies to improve the competitiveness of agricultural production by supporting access to finance for farmers (Agricultural Ministry of Indonesia 2011). Farmers in Indonesia can access finance from various finance providers, i.e. banks, MFIs and other finance sources, such as friends or relatives (Machmud and Huda 2011).

1.2 Description of finance providers

Indonesian farmers can obtain finance from many different finance providers as indicated in Table 1.1. Commercial credit can be obtained from banks and MFIs. Besides commercial credit, a subsidised credit programme is provided by some banks collaborating with the Indonesian government. Farmers who are members of a farmers' association can

obtain finance from farmers' association in the form of in-kind finance such as seeds, fertilizers and pesticides. The Indonesian government provides the associations with seeds and fertilizers, farm equipment and subsidies to purchase seeds and fertilizers. Also, the government provides the associations with cash aid through the rural agribusiness development programme (*PUAP-Pengembangan Usaha Agribisnis Perdesaan*). In return, some farmers' associations require members to sell their products to the farmers' association under the conditions set in the contract between the farmers' association and members. Also, in-kind finance is provided by some traders for farmers who have a sales contract with the trader.

Table 1.1 Finance providers in Indonesia

Finance providers	Type of finance
Bank	Commercial credit, subsidised credit
MFI	Commercial credit
Farmers' association	In-kind finance
Trader	In-kind finance
Agricultural input kiosk	Flexible payments of inputs
Others	Any type of finance such as credit or in-kind finance

Some agricultural input kiosks provide finance to farmers by selling inputs such as seeds, fertilizers and pesticides for a flexible payment conditions, which enable farmers to pay for the inputs between one week and one month after purchase. Some kiosks allow farmers to pay for the inputs after harvesting, as long as the farmers agree to sell the harvest to the kiosk. Family and friends serve as *other finance providers*. Informal sources of finance are traditionally important for people in rural areas, as they supply short-term credit for the urgent

demands of farming households. These urgent demands are usually not met by the formal sector, such as banks and MFIs (Duong and Izumida 2002).

1.3 Problem statement

Previous studies have shown that the availability of finance is important for the efficient use of resources in the agricultural sector (Ayaz and Hussain 2011). However, access to finance is still a major problem faced by actors in the agricultural sector of Indonesia (Ashari 2009). Farmers do not have access to finance from financial institutions easily due to strict procedures and requirements or because interest rate is high (Nurmanaf et al. 2006). Moreover, Irianto and Poernomo (2008) showed that finance is often limiting agricultural development, also in rural areas of Indonesia. A number of studies have shown that farmers who obtained credit have a better performance than farmers who did not obtain credit (Carter 1989; Ahmad et al. 2002; Ammani 2012). Furthermore, production risks could be reduced by better access to finance. Finance, for instance credit may enable farmers to purchase irrigation equipment that can reduce the effects of weather on yield variability (Wossen et al. 2014). Also, credit can be used to purchase inputs such as feeds, fertilizer, insecticides and fungicides, which lead to a decrease in production risk (Angelucci and Conforti 2010). Moreover, farmers need finance to purchase inputs in advance before harvesting (Angelucci and Conforti 2010), therefore, finance is very important to help contracted farmers to fulfil a contract by producing output as required in the contract. However, the existing literature focused mostly on finance obtained from a particular finance source, whereas finance can be obtained from different types of finance providers, with potentially different effects on farm performance.

Finance providers typically differ in the type of inputs they enable access to, and hence are expected to have different effects on performance and risk. For instance, commercial credit from banks may come in the form of large loans, which can be used to purchase irrigation equipment that can boost production (Wossen et al. 2014), and may lead to more stable yields. Subsidised credit from banks is granted mostly for investing in equipment or renovation of old buildings (Brummer and Loy 2000). MFIs provide necessary financial means to have better access to both higher quantity and better quality of production inputs such as improved seeds, fertilizers and pesticides (Girabi and Mwakaje 2013). Thus, credit from MFIs may also help farmers to achieve higher and more stable yields. Furthermore, production inputs such as seeds, fertilizers and pesticides can be better accessed by being a member of a farmers' association (Lamprinopoulou et al. 2006) or having a contract with a trader (Schipmann and Qaim 2011). Agricultural input kiosks provide finance in the form of flexible payments of inputs, which may help farmers with liquidity constraints to obtain inputs especially during the planting and growing periods (Binam et al. 2004). A similar reasoning applies to finance provided by so-called "other sources" including family and friends, i.e. also this source may help liquidity constrained farmers to obtain agricultural inputs such as seeds, fertilizers and pesticides during planting and growing periods (Bozoglu and Ceyhan 2007).

Finance providers may also differ in terms of the incentives given to farmers and also for that reason have different effects on performance and risk. For instance, farmers need to make a business plan to apply credit from a bank (Pretorius and Shaw 2004). Pretorius and Shaw further explained that the business plan provides a business guidelines and information about all activities of the business, which encourages the bank to give credit. Farmers can benefit from writing a business plan as it could make farmers more aware of the mechanisms to improve farm performance. As a study of Noordhuizen et al. (2008) showed that a business

plan provides a business direction and strategy that needs to be followed by farmers to improve the performance. Furthermore, farmers need to become member of an association in order to obtain in-kind finance from the association (Lamprinopoulou et al. 2006). By joining as an association member, a farmer benefited from the information on crop management (Konare 2001). To obtain in-kind finance from a trader, farmers need to have a contract with the trader (Schipmann and Qaim 2011). The contract specifies rules for production, such as cultivation procedures, the amount of produce to be delivered and prices.

1.4 Objectives of the research

The overall objective of this thesis is to analyse the relation between finance utilisation from different finance providers and horticultural business performance in Indonesia. More specifically, the overall objective is subdivided into four specific sub-objectives:

1. to compare farmer knowledge of the requirements to obtain finance with the actual requirements set by finance providers, and investigate factors that determine farmer knowledge of the requirements.
2. to analyse the relation between the technical efficiency of horticultural farms and finance utilisation from different finance providers including finance from banks, MFIs, farmers' associations, traders, agricultural input kiosks and so-called "other sources" such as family and friends.
3. to analyse the relation between finance utilisation from different finance providers and farmers' perceived production risk.
4. to analyse the relation between contract fulfilment and finance utilisation from different finance providers.

1.5 Description of the study area

This study was conducted in Java Island, the main area of horticultural production for four selected crops in Indonesia, i.e. mango, mangosteen, chili and red onion. These crops were identified by the Indonesian ministry of agriculture as key crops for horticultural development in Indonesia (Agricultural Ministry of Indonesia 2011). The horticultural crops included per region in Java are presented in Figure 1.1.

Figure 1.1 The horticultural crops included per region in Java

Within Java, study sites were selected based on the importance of horticultural production, especially for the selected crops. Java is divided into provinces. Firstly, two provinces were selected as study sites for each selected crop, based on the largest production area and the potential to develop the selected crop. According to data from the Central Bureau of Statistics in Indonesia (BPS 2013), production of mango occurs mainly in West Java and

East Java, and the production of chili, red onion and mangosteen occurs mainly in West Java and Central Java.

Next, for each province, districts with the highest production during the last five years were selected. For mango, the chosen districts were Cirebon and Indramayu (West Java), and Probolinggo and Pasuruan (East Java). The chosen districts for mangosteen were Tasikmalaya and Subang (West Java), and Purworejo (Central Java). For chili, selected districts were Garut, Tasikmalaya and Ciamis (West Java), and Pemalang and Purbalingga (Central Java). Finally, the selected districts for red onion were Majalengka and Bandung (West Java), and Brebes (Central Java).

1.6 Outline of the thesis

This thesis consists of six chapters including a general introduction (Chapter 1), four research chapters (Chapter 2-5), and a general discussion (Chapter 6). Chapter 2 compares farmer knowledge of the requirements to obtain finance with the actual requirements set by finance providers, and investigates factors that determine farmer knowledge of the requirements. This chapter presents the current knowledge of farmers about important requirements to obtain finance from different sources of finance. Furthermore, the relation of different factors with farmer knowledge is investigated using a censored regression model.

Chapter 3 analyses the relation between finance utilisation from different finance providers including finance from banks, MFIs, farmers' associations, traders, agricultural input kiosks and so-called "other sources" such as family and friends and the technical efficiency of horticultural farms. First, an output-oriented Data Envelopment Analysis approach is used to estimate the technical efficiency of selected farms. This was followed by a

bootstrap truncated regression in the second stage to estimate the relation with finance and socio-economics factors.

Chapter 4 analyses the role of finance utilisation from different providers of finance in production risk. This chapter elicits perceived yields that can be obtained in the next five years given the current use of inputs, finance obtained from a particular finance provider, disease pressure and physical growth conditions. Production risk then is measured using various measures of risk.

Chapter 5 analyses the relation between finance utilisation and chili supply continuity as reflected by the rates of contract fulfilment. A censored regression is used to investigate the relation of different factors with contract fulfilment.

Finally, Chapter 6 discusses the main findings of this research as well as the policy and business implications. This chapter synthesises the results and discusses the data and methods used in this thesis, suggests future research, and draws the main conclusions.

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Chapter 2

Finance Utilisation from Different Finance Providers: Farmer Knowledge of the Requirements

Eliana Wulandari[a b], Miranda P. M. Meuwissen[a], Maman H. Karmana[b], and Alfons G. J. M. Oude Lansink[a]

[a] Business Economics, Wageningen University, Wageningen, The Netherlands.

[b] Faculty of Agriculture, University of Padjadjaran, West Java, Indonesia

Submitted for publication

Abstract

Analysing farmer knowledge of the requirements of finance providers can provide valuable insights to policy makers about ways to enhance the availability of finance for farmers. This study compares farmer knowledge of the requirements to obtain finance with the actual requirements set by finance providers, and investigates factors that determine farmer knowledge of the requirements. A structured questionnaire is used to collect data from a sample of finance providers and farmers in Java Island, Indonesia. The results show that the most important requirements to acquire finance vary among different finance providers. Farmers generally have little knowledge of the requirements, which are important to each type of finance provider. Awareness campaigns are needed to increase farmer knowledge of the diversity of requirements among the finance providers.

Keywords: Farmer knowledge, censored regression, horticulture, Indonesia

2.1 Introduction

Availability of finance is important for sustaining the production of agricultural commodities (De Castro and Teixeira 2012; Ahangar et al. 2013). Moreover, availability of finance contributes to increased income (Mosley and Hulme 1998; Foltz 2004), productivity improvements (Carter 1989; Obilor 2013) and efficiency improvements (Ayaz and Hussain 2011). Previous studies have identified the different types of finance providers (Kaino 2005; Pham and Lensink 2007; Armendariz and Labie 2011). Lack of access to finance is a major problem for the rural poor, especially in developing countries (Basu and Srivastava 2005; Hermes and Lensink 2007).

A number of studies have shown the importance of the knowledge of finance providers. Swinnen and Gow (1999) showed that access to finance might be constrained because finance providers lack information about the agricultural sector. Knowledge-based factors influenced the assessment of the credit-worthiness of borrowers (Petrick 2004) and the credit-rating of applicants (Duong and Izumida 2002). Armendariz and Morduch (2010) pointed out that financial services were improved by lenders' information about borrowers.

Financial knowledge is important for financial decision making (Kozup et al. 2008). A lack of financial knowledge, especially of farmers, can explain the low income of farmers and slow economic growth (Yuxia 2013). Despite the importance of financial knowledge, some studies have explored the financial knowledge of farmers (Yuxia 2013; Sayinzoga et al. 2014; Gaurav and Singh 2012; Ravikumar et al. 2013), but none have studied farmer knowledge of the requirements to obtain finance from different finance providers. Analysing farmer knowledge of the requirements of finance providers can help identify opportunities to improve farmers' opportunity to obtain finance. In this context, the first objective of this study is to compare farmer knowledge of the finance requirements of different finance providers

with the requirements set by the finance providers. The second objective is to investigate the factors that determine farmer knowledge of finance requirements. The results of this study provide insights which are useful to design strategies to improve farmer knowledge of finance and subsequent access to finance.

The empirical application focuses on a sample of horticultural farmers in Indonesia. Agriculture is an important and growing sector in the Indonesian economy, accounting for 14.7% of Indonesian gross domestic product in 2011 (Centre for Agricultural Data and Information System of Indonesian Ministry of Agriculture 2012). The export value of horticulture grew 22.8% per year from 2007 until 2011 (Centre for Agricultural Data and Information System of Indonesian Ministry of Agriculture 2012). Horticulture can become an important source of income for Indonesian farmers as it has high economic value.

2.2 Finance from different types of finance providers in Indonesia

The Indonesian government aims to develop horticulture, among other agricultural sectors, by improving access to credit (Agricultural Ministry of Indonesia 2011). Farmers can access finance from various finance providers, such as banks, credit associations, private moneylenders, relatives (Pham and Lensink 2007), micro finance institutions (MFIs) (Kaino 2005), traders (Umberger et al. 2015) and credit cooperatives (Mujawamariya 2013). This section discusses in detail the requirements to obtain finance, which are set by the different finance providers in Indonesia.

2.2.1 Finance from banks

Farmers can access finance from banks by applying for commercial credit. The loan duration depends on the policy of the bank, the type of commercial credit and the amount of

credit applied for. For instance, farmers may apply for working capital credit for a duration of 12 or 36 months, dependent on the amount of credit needed. A farmer can apply for commercial credit by completing a credit application form and providing supporting documents. The supporting documents are required to prove identity and provide evidence of collateral. Examples of supporting documents include: photocopies of the identity cards of the applicant and his/her partner in case of marriage, and photocopies of land certificates, salary slips, deposits or a certificate of vehicle ownership. Banks then analyse the credit application by interviewing the applicant or conducting a farm visit.

Farmers can also apply for a subsidised credit programme, offered by banks collaborating with the Indonesian government. An example is the programme of micro credit loans (*KUR-Kredit Usaha Rakyat*). The KUR aims to help farmers, especially those who do not have any collateral. The KUR guidelines of the Agricultural Ministry of Indonesia (Agricultural Ministry of Indonesia 2013) specify a number of conditions, such as the size and length of the loan, which depend on the type of the KUR. For micro KUR, for instance, farmers may borrow up to IDR 20 million (the exchange rate in 2013, US$1 = IDR 10,445) for a maximum of 3 years. To obtain credit from the KUR, an applicant needs to make a proposal, which is endorsed by the local agricultural officer. Next, a form for credit application is completed and submitted together with the proposal to a selected bank. The bank analyses the feasibility of the proposal and conducts a farm visit to decide on approval. The KUR programme is run by a selected group of banks.

2.2.2 Finance from micro finance institutions (MFIs)

MFIs play an important role in the provision of credit to farmers in Indonesia. To obtain credit from MFI, farmers are required to register as a member of the MFI. Following

membership, a farmer is allowed to submit a credit application. The financing from MFI benefits small farmers who cannot obtain credit from banks.

2.2.3 Finance from farmers' associations

Farmers' associations generally exploit many activities, including selling the products of their members. Farmers' associations have access to finance, especially through government programmes. Farmers' associations channel government aids to farmers who are members of the farmers' association. The government provides the associations with cash aids, seed and fertilizer aids, farm equipment and subsidies to purchase seed and fertilizer. Cash aids are provided through the rural agribusiness development programme (*PUAP-Pengembangan Usaha Agribisnis Perdesaan*). This programme targets farmers' associations to motivate farmers to increase production. Governmental provision of finance via farmers' associations is based on past experience in Indonesia, showing that a group approach strongly affects the success of a programme (Budisatria and Udo 2013). To access this source of finance, farmers' associations need to submit a proposal of their agricultural business plan to the local government. The local government verifies the proposal and documents. Evaluation criteria are location in a PUAP area, sufficient human resources for operating agribusiness activities and active farm management by farmers (Agricultural Ministry of Indonesia 2011). If the criteria are fulfilled, the proposal is submitted to the director of finance at the Agricultural Ministry of Indonesia. The associations then distribute the finance obtained from the government to their members. Finance is provided in-kind, i.e. by distributing agricultural inputs to their members. In return, some farmers' associations require members to sell their products to the farmers' association under the conditions set in the contract between association and members.

2.2.4 Finance from traders

Some traders in Indonesia provide finance in-kind to those farmers who have contracts with the traders. The contract is set by the trader and farmers together and stipulates rules for production, such as cultivation procedures, the amount of produce to be delivered and prices. Both traders and farmers benefit from this contract, as farmers have both a buyer for their products and a guaranteed price, and traders have guaranteed continuity of supply.

2.2.5 Finance from agricultural input kiosks

Some agricultural input kiosks provide finance to farmers by selling inputs, such as seed, fertilizer and pesticides, for a flexible payment. The flexible payment means that farmers can pay for the input a week to a month after purchasing. Some kiosks allow farmers to pay for the inputs after harvesting, as long as the farmers agree to sell the harvest to the kiosk.

2.2.6 Finance from other finance providers

Farmers can also obtain finance from other finance providers, such as family and friends. Informal finance is a major source of finance, especially for poor people (Armendariz and Labie 2011). Interest is not usually charged for informal finance (Khandker and Faruqee 2003).

2.3 Research methods

This section describes the conceptual framework, procedure of survey, the survey of finance providers and farmers, and the analytical methods used in this study.

2.3.1 Conceptual framework

The conceptual framework is presented in Figure 2.1. The finance requirements are based on the theory of risk assessment in finance, reported by Miller (2008). The determinants of farmer knowledge are derived from a literature review. The factors that influence the provision of finance are presented on the left hand side of Figure 2.1. Finance providers focus on the five Cs of lending i.e. collateral, character, capacity, capital and condition (Miller 2008). In this study, the following definitions is used for the five Cs. *Collateral* is defined as a farmer's guarantee letters, such as land and vehicle certificates. *Character* is defined as a farmer's history of loan repayments. *Capacity* is defined as the profitability of farms. *Capital* is defined as savings and *condition* as the national political and macroeconomic situation in the country, which influences the decisions of finance providers on the distribution of finance. Relevant factors that affect the national situation include inflation and national elections.

Additional variables were included in the finance provision part of the conceptual framework based on a review of relevant literature. Previous studies have found that the success of obtaining finance is determined by the amount of credit applied for (Duong and Izumida 2002), the ability of farmers to manage their farms as shown by their experience (Anyiro and Oriaku 2011), farm size (Anyiro and Oriaku 2011; Tasie and Offor 2013; Awunyo-Vitor et al. 2014), and membership of a village or farmers' association (Obisesan 2013). Furthermore, Glover (1984) pointed out that having a contract in agriculture is not only beneficial for market access, but also eases access to credit. The additional variables included in the finance provision part of the conceptual framework are: *loan size*, defined as the amount of money needed by the farmers; *farmer ability*, defined as the ability of the farmer to manage their farm; *farm size*; *spouse knowledge*, defined as whether the spouse knows about the finance application; *membership* of a registered farmers' association and presence of a *sales contract*.

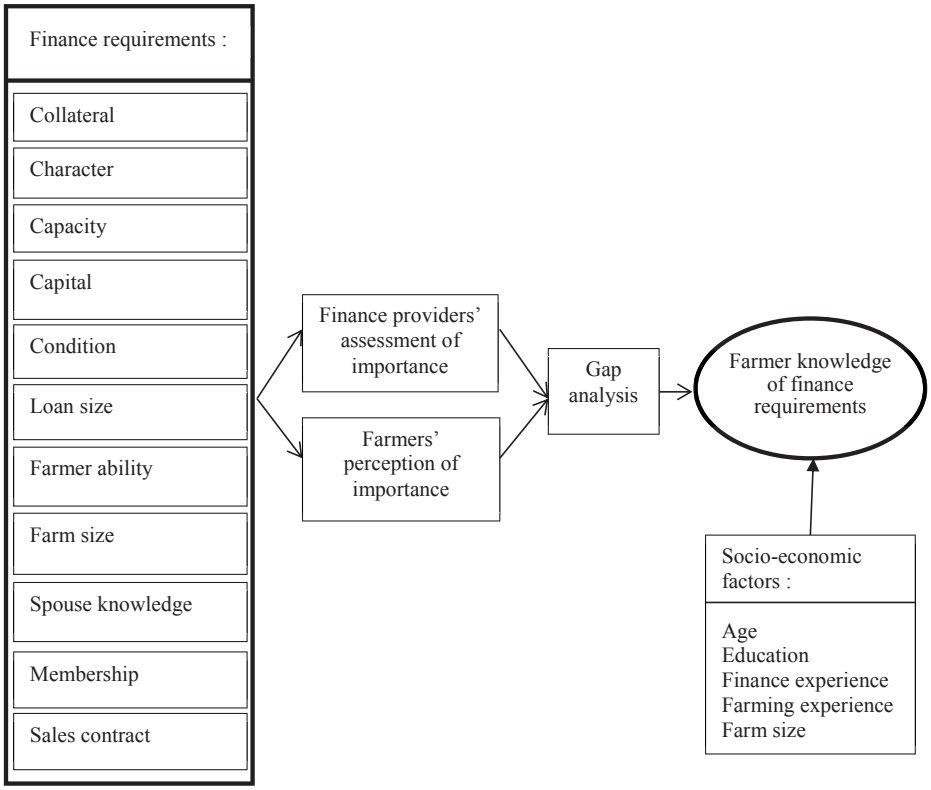

Figure 2.1. Conceptual framework

The determinants of farmer knowledge of finance requirements are shown on the right hand side of Figure 2.1. Several studies have shown that farmer knowledge is influenced by socio-economic factors. Education, farm size, farming experience and finance experience were significant variables that determined farmer knowledge of the risks and benefits of herbicide-tolerant canola in Western Canada (Mauro and McLachlan 2008). Similarly, Kumar Jha (2012) reported that education and size of land holding were important in determining the level of knowledge of social forestry practices. Furthermore, Harrison (2006) found that age significantly influenced the knowledge of farmers about financial management practices.

2.3.2 Procedure of survey

This study is part of a comprehensive project, reviewed and approved by the Assessment Committee of Wageningen School of Social Sciences (WASS). A letter of the project team, accompanied with a letter from the embassy of Indonesia in The Netherlands as well as a permission letter from Faculty of Agriculture, Padjadjaran University, Indonesia were used as supporting letters sent to finance providers. The same letters were used during the farmers' survey. From the agricultural offices in study areas, verbal permission was obtained. Participation was strictly voluntary and written and oral consent were obtained from finance providers and farmers respectively. With regard to the latter, oral consent was opted because part of the target population had little schooling. The same procedure was followed by among others Reyes-Garcia et al. (2016). Next, participants were introduced to the study purpose and contents before entering the survey. The questionnaires for finance providers and farmers include personal information of participants. Therefore, anonymity was acknowledged and assured with an anonymous data set.

2.3.3 Survey of finance providers

Questionnaire design. The structured questionnaire was designed for the finance providers to identify the most important requirements for farmers to obtain finance. A five-point Likert-scale (ranking from 1 to 5) was used to elicit finance providers' perceptions of the important requirements, following the method of Wyatt and Meyers (1987). The questionnaire was pretested to see if any important requirements were missed.

Data collection. During the period from August 2013 to July 2014, data were collected from 43 finance providers: banks (6), MFIs (5), farmers' associations (13), traders (6) and agricultural input kiosks (13). These providers all had horticultural farms in their portfolio and the majority of their business in Java, the same region as the surveyed farmers. Contact details

for banks and traders were provided by the Agricultural Ministry of Indonesia. Contact details for MFIs, farmers' associations and agricultural input kiosks were obtained from personal contacts, including agricultural officers and agricultural networks. In total, 80 finance providers were contacted, of which 43 agreed to participate in this study.

The 6 banks operate as saving and lending institutions. The banks had 4,800 to 26,000 employees and 24 to 100 years of experience in financing farmers. Commercial and subsidised credit were not distinguished in the questions on the finance requirements of banks. The 5 MFIs had 5 to 19 years of experience in financing farmers. The 13 farmers' associations had 13 to 248 members and 2 to 40 years of experience. The 6 traders are mainly export traders. These traders had 11 to 23 years of experience providing finance to farmers and had 7 to 460 employees. The 13 agricultural input kiosks had 3 to 16 years of experience providing inputs to farmers. The kiosks had 1 to 4 employees and 30 to 300 farmers as customers. Informal finance providers, such as family and friends, were not included in the survey.

2.3.4 Survey of farmers

***Questionnaire design*.** The questionnaire was designed for farmers to investigate farmer knowledge of the requirements set by different finance providers. A five-point Likert-scale (ranking from 1 to 5) was used to elicit farmers' perceptions of the importance of the different finance requirements for each provider. The questionnaire was pretested to evaluate consistency and clarity, and to avoid duplicate questions. The questions covered two main areas: socio-economic variables and knowledge of important requirements to obtain finance. The requirements to obtain finance were identical to those in the questionnaire for the finance providers.

Data collection. The survey was conducted from January 2014 to July 2014. The study sites were characterised by mixed commodity farming, as most farmers in Indonesia grow more than one commodity on their farms. Data were collected from farmers who cultivate one or more of the following as their main crop: mango, mangosteen, chili and red onion. These four crops were selected because the Indonesian Ministry of Agriculture has identified them as key products for horticultural development in Indonesia (Agricultural Ministry of Indonesia 2011). The study sites were selected based on the value of production for the four crops. According to data from the Central Bureau of Statistics in Indonesia (BPS) (2013), Java Island has the highest production of all selected commodities. Therefore, survey was conducted on Java Island.

Java Island is divided into provinces, which are formed by several districts. Two provinces were selected as study sites for each commodity, based on the largest area of production and the potential to develop the selected commodity. The provinces were selected according to data from the BPS (2013): West Java and East Java for mango, and Central Java and West Java for chili, red onion and mangosteen. Within each province, the districts with the highest production during the last five years were selected, again using data from the BPS (2013). In West Java, the chosen districts are: Garut, Tasikmalaya and Ciamis for Chile; West Bandung and Majalengka for red onion; Tasikmalaya and Subang for mangosteen; and Cirebon and Indramayu for mango. In Central Java the chosen districts are: Brebes for red onion, Purworejo for mangosteen, and Pemalang and Purbalingga for chili. Finally, Probolinggo and Pasuruan were selected for the production of mango in East Java.

With regard to the selection of farmers per district, farmers were randomly selected based on farm address data obtained from agricultural officers and personal contacts. The sample contains 434 farmers: 101 producing mango, 103 producing mangosteen, 123

producing chili and 107 producing red onion. The characteristics of the farms in the sample are presented in Table 2.1.

As shown in Table 2.1, on average, farmers were 47 years old and had 8 years of formal education background. Farmers had an average of 24 years of experience in farming activities. The average farm size was 1.02 hectares, and ranged from 0.69 to 1.30 hectares across the four types of farmers. The highest percentage of finance was obtained from farmers' associations. Most of the mango, mangosteen and chili farmers had previously obtained finance from farmers' associations, whereas almost half of red onion farmers had previously obtained finance from agricultural input kiosks.

Table 2.1 Socio-economic characteristics of farms in the sample

Dimension	Variable	Mango (n=101)	Mangosteen (n=103)	Chili (n=123)	Red onion (n=107)	Overall (n=434)
Farmer	Age [a] (years)	46 (0.93)	53 (1.11)	41 (0.86)	49 (0.91)	47 (0.52)
	Education level [a] (years)	9 (0.25)	8 (0.26)	8 (0.25)	7 (0.22)	8 (0.13)
	Farming experience [a] (years)	23 (1.13)	31 (1.42)	15 (0.86)	28 (1.17)	24 (0.64)
Farm	Farm size [a] (hectares)	1.30 (0.30)	0.87 (0.07)	1.20 (0.20)	0.69 (0.15)	1.02 (0.10)
Finance experience [b]	Bank (%)	25	25	18	21	22
	MFI (%)	5	17	4	10	9
	Farmers' association (%)	26	45	63	34	43
	Trader (%)	10	10	46	11	20
	Agricultural input kiosk (%)	8	1	27	47	21

[a] Mean values with standard errors in parentheses.
[b] Percentage of respondents who have previously obtained finance from the finance provider.
Source: Authors' calculation

2.4 Analytical methods

First which requirements were perceived to be the most important to obtain finance from different finance providers were determined, from the perspective of both finance providers and farmers. The most important requirements were defined as the requirements which scored either 4 (important) or 5 (very important). Furthermore, a chi square test was performed to see whether the percentage of finance providers and farmers who perceived a requirement to be important was significantly different across finance providers.

A gap analysis then was used to compare farmer knowledge of the important finance requirements with the important requirements as stated by the finance providers. First, the five requirements which were rated as most important for each finance provider were selected. For each finance provider, these five most important requirements were then matched with the important requirements identified by each farmer. A knowledge score of 1 indicates that a farmer correctly identified all five requirements as important. A knowledge score of 0.8 indicates that a farmer correctly identified four of the five requirements as important.

Lastly, a censored regression model was used to investigate the factors, which determine farmer knowledge of the importance of finance requirements. The generic form of a censored model (Verbeek 2004) is:

$$y_i^* = x_i' \beta + \varepsilon_i , \quad i = 1, 2, ..., N \qquad (1)$$

Following the generic form above, the model is :

$$y_{ij}^* = \beta_1 + \beta_2 \text{ age} + \beta_3 \text{ educ} + \beta_4 \text{ finexp}_j + \beta_5 \text{ fexp} + \beta_6 \text{ fsize} + \varepsilon_i \qquad (2)$$

i = 1, 2, ..., N (N=434 farmers),

j = 1, 2, ..., N (N=43 finance providers).

where the dependent variable y_{ij}^{*} is the knowledge score, which captures each farmer's knowledge of the important requirements for each finance provider. The independent variables ($x_{i'}$) are the socio-economic factors, which were expected to influence farmer knowledge. The socio-economic variables are *age* (age), *education level* (educ), *finance experience* from a specific finance provider ($finexp_j$), i.e. whether a farmer had previously obtained finance from a specific provider, *farming experience* (fexp) and *farm size* (fsize). The variable *finance experience* is a dummy variable, which takes the value of 1 if a farmer had previously obtained finance from a specific finance provider and 0 otherwise. Variables were standardised to ensure that all variables contributed evenly to a scale when items were added together. Homoscedasticity was tested using the Breusch-Pagan test and checked for multicollinearity by calculating the Variance Inflation Factors (VIF) for each variable. When the problem of multicollinearity was found, then the problem was corrected by removing variables that have VIF values of more than 10. Rook et al. (1990) suggested a model is free from multicollinearity problem when the VIF of all variables are below 10. The presence of reverse causality was also tested in *finance experience* and *farm size*. For example, reverse causality in *farm size* could occur if having more knowledge of the finance requirements to obtain credit from a bank also allows farmers to attract more finance and rent more land.

2.5 Results and discussion

2.5.1 Important requirements to obtain finance: perspective of finance providers

Table 2.2 shows that the most important requirements to obtain finance vary among finance providers. For instance, banks perceive *character*, *capacity*, and *farmer ability* as most important. Contrary to findings from previous studies (Khandker and Faruqee 2003; Foltz 2004), the results show that *collateral* is not the most important requirement to obtain

finance from a bank. *Collateral* may be less important for banks in Indonesia because of the subsidised credit programme provided by the Indonesian government. For example, in the KUR programme, farmers can borrow money from banks without any collateral. MFIs have different requirements from banks, although they both provide credit. For instance, in addition to *character*, MFIs also perceive *spouse knowledge* as an important requirement to obtain finance (Table 2.2).

Table 2.2 Important finance requirements from the perspective of different finance providers [a]

Finance requirement	Bank (n=6)	MFI (n=5)	Farmers' association (n=30)	Trader (n=6)	Agricultural input kiosk (n=13)
Collateral [b,c]	83.3	40.0	53.8	33.3	7.7
Character [b,d]	100.0	100.0	53.8	83.3	46.2
Capacity [b,e]	100.0	80.0	92.3	83.3	30.8
Capital [b,f]	66.7	60.0	61.5	16.7	0.0
Condition [b,g]	83.3	0.0	15.4	33.3	7.7
Loan size [b]	66.7	80.0	76.9	50.0	15.4
Farmer ability [b,h]	100.0	60.0	92.3	100.0	15.4
Farm size [b]	83.3	60.0	84.6	83.3	15.4
Spouse knowledge [b,i]	66.7	100.0	61.5	0.0	7.7
Membership [b,j]	33.3	60.0	100.0	66.7	15.4
Sales contract [b,k]	50.0	20.0	53.9	100.0	15.4

[a] Percentage of respondents who scored the factors as important or very important (score 4 and 5).
[b] Indicates significant difference between finance providers (P≤0.05).
[c] *Collateral*: a farmer's guarantee letters, such as land and vehicle certificates.
[d] *Character*: a farmer's history of loan repayments.
[e] *Capacity*: the profitability of a farm.
[f] *Capital*: savings.
[g] C*ondition*: the national political and macroeconomic situation in the country.
[h] The ability to manage the farm.
[i] Whether the spouse knows of the application for finance.
j Membership of a registered farmers' association.
k Presence of a sales contract.
Source: Authors' calculation

Providers of in-kind finance have different requirements. Farmers' associations perceive *membership* as the most important requirement to obtain in-kind finance, whereas traders

perceive this requirement to be less important. Instead, traders perceive *farmer ability* and *sales contract* to be the most important requirements (Table 2.2). This is consistent with Irianto et al. (2006), who found that contracts between farmers and traders for the provision of credit and technical assistance, such as the terms of planting, can be implemented to overcome financial constraints.

Agricultural input kiosks perceive *character* as the most important requirement to obtain finance (Table 2.2). Similar results are shown by Schreiner (2004), who also found that a person's history of credit repayment is important for a lender to provide a loan. Furthermore, credit history, which represents the ability to repay debts, is important due to its relation to the probability of default in a credit programme (Serrano-Cinca et al. 2015).

The results show that the requirements differ significantly between finance providers ($P \leq 0.05$), except for *character*, which is perceived as relatively important by all providers (Table 2.2).

2.5.2 Importance of finance requirements: perception and knowledge of farmers

Farmers' perceptions of the important requirements to obtain finance also vary across finance providers (Table 2.3). From the perspective of farmers, the most important requirement to obtain finance from a farmer's association is *membership*. However, only 80 percent of farmers perceive *membership* as very important (Table 2.3). Some farmers, especially farmers who are not a member of a registered farmers' association, appear to be unaware that *membership* is very important to obtain finance from this provider. Farmers perceive *collateral* as the most important requirement to obtain finance from a bank. Furthermore, farmers perceive *character* as important to obtain finance from a MFI, trader and agricultural input kiosk.

A comparison of farmers' and finance providers' assessments shows that the requirements perceived as important by farmers often do not match the requirements set by the finance providers. Banks perceive *character*, *capacity* and *farmer ability* as the most important requirements (Table 2.2), whereas farmers perceive that banks do not focus on these requirements (Table 2.3). Farmers also perceive *farmer ability* and *sales contract* as not the most important to obtain finance from a trader (Table 2.3), whereas these variables are the most important requirements from the perspective of the traders (Table 2.2).

Table 2.3 Farmers' perceptions of the important requirements to obtain finance from finance providers [a] (n=434)

Finance requirement	Bank	MFI	Farmers' association	Trader	Agricultural input kiosk
Collateral [b,c]	97	59	32	12	8
Character [d]	80	70	58	51	53
Capacity [b,e]	57	34	32	16	11
Capital [b,f]	88	48	29	2	2
Condition [b,g]	18	15	21	6	5
Loan size [b]	73	58	46	32	25
Farmer ability [b,h]	46	22	30	16	10
Farm size [b]	34	20	23	13	10
Spouse knowledge [b,i]	94	69	39	22	18
Membership [b,j]	15	14	80	4	4
Sales contract [b,k]	14	9	15	40	5

[a] Percentage of farmers who scored the factors as important or very important (score 4 and 5).
[b] Indicates significant difference between farmers' perception to get finance from each finance providers (P≤0.05).
[c] *Collateral*: a farmer's guarantee letters, such as land and vehicle certificates.
[d] *Character*: a farmer's history of loan repayments.
[e] *Capacity*: the profitability of a farm.
[f] *Capital*: savings.
[g] *Condition*: the national political and macroeconomic situation in the country.
[h] The ability to manage the farm.
[i] Whether the spouse knows of the application for finance.
j Membership of a registered farmers' association.
k Presence of a sales contract.
Source: Authors' calculation.

The results show that farmers' perceptions of the important requirements for obtaining finance are significantly different across finance providers (P≤0.05). Farmers perceive that

traders and input kiosks have the least strict requirements. The gap in the perceived importance of requirements between finance providers and farmers is illustrated by the relatively low knowledge scores of farmers, as shown in Table 2.4. These scores imply that the majority of farmers have a relatively little knowledge of the requirements to obtain finance from different finance providers. Farmer knowledge is highest with respect to the requirements of banks (0.63), whereas the lowest score is for knowledge of the requirements of the kiosks (0.17) .

Table 2.4 Mean farmer knowledge scores and coefficients from the censored regression of knowledge scores on the influencing factors (n=434), standard errors in parentheses

Variable	Bank	MFI	Farmers' association	Trader	Agricultural input kiosk
Farmer knowledge score	0.63	0.56	0.42	0.27	0.17
Constant	0.63	0.53	0.40	0.22	0.07
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Age (years)	-0.01	0.02	-0.03	0.00	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education level (years)	-0.02	-0.01	0.05 [a]	-0.02	-0.03 [a]
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Finance experience [d]	-0.03	0.08	0.05 [c]	0.03	0.09 [a]
(dummy variable)	(0.03)	(0.06)	(0.03)	(0.04)	(0.03)
Farming experience (years)	-0.05 [a]	-0.08 [a]	0.03	-0.03	-0.08 [a]
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Farm size (hectares)	0.02 [c]	0.00	0.01	0.03 [a]	0.04 [a]
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)

[a] Significant at 1%, [b] significant at 5% and [c] significant at 10% level.
[d] Dummy variable representing whether the respondent had previously obtained finance from the finance provider; 1 if yes, 0 otherwise.
Source: Authors' calculation.

2.5.3 Determinants of farmer knowledge of finance requirements

The results of the censored regression model to identify factors that influence farmer knowledge of the important finance requirements (referred to as famer knowledge in this section) are presented in Table 2.4. Among the socio-economic factors, *education level*

significantly and positively associates with farmer knowledge for farmers' associations. This result implies that higher-educated farmers, *ceteris paribus*, have more knowledge of the finance requirements of farmers' associations. However, *education level* was also found has a significant, negative association with farmer knowledge for the agricultural input kiosk, which means that less-educated farmers have more knowledge of the important requirements to obtain finance from a kiosk. This result suggests that less-educated farmers might focus on obtaining finance from kiosks because they think they were unlikely to obtain finance from banks and MFIs. Previous studies on finance did not explore the relation between knowledge of requirements and education level. However, a positive association between education and knowledge about brucellosis disease was found by Lindahl et al. (2015).

Finance experience is significantly associated with farmer knowledge for farmers' associations. This implies that farmers who previously obtained finance from farmers' associations are more knowledgeable about the requirements. Similarly, *finance experience* has a significant positive association with farmer knowledge for kiosks.

The other socio-economic factors, i.e. *farming experience* and *farm size*, have a significant association with farmer knowledge for at least one type of finance provider. *Farming experience* has a significant, negative association with farmer knowledge for banks, MFIs, and agricultural input kiosks, indicating that more-experienced farmers have less knowledge of the finance requirements of these three providers. More management experience may have made their farms more robust and therefore less dependent on access to finance. Previous studies on finance did not investigate the relation between knowledge of requirements and farming experience. Jabbour et al. (2014) showed that farming experience was positively correlated with the knowledge of farmers, particularly in weed management.

Results in Table 2.4 also show that *farm size* has a significant, positive association with farmer knowledge for banks, traders and kiosks. This result implies that farmers operating

larger farms, *ceteris paribus*, have more knowledge of the finance requirements of these three providers, which suggests they focus on finding finance from sources that can improve their production, e.g. for adopting new technologies. Mauro and Mac Lachlan (2008) showed that farmers operating larger farms focus on technology development, leading to improved knowledge of risk assessment on their farms.

The causality of the relation between several statistically significant variables and farmer knowledge was investigated, using a reverse causality test. For the farmers' association, no evidence was found for reverse causality in the relation between farmer knowledge and *finance experience*. However, for agricultural input kiosks, the test provided evidence of reverse causality between farmer knowledge and *finance experience*. Hence, although the relation between *finance experience* from the kiosk and farmer knowledge is positive, the direction of the causality is unknown. Similarly, for banks and agricultural input kiosks, farmer knowledge has a significant, positive association with *farm size*. An evidence was found for reverse causality between farmer knowledge and *farm size* for these two providers. Therefore, for banks and kiosks, the causality in the relation between *farm size* and farmer knowledge is also unknown.

2.6 Conclusions and Recommendations

This study compares farmer knowledge of the finance requirements of different finance providers with the requirements as stated by the finance providers. Furthermore, it investigates the factors that determine this knowledge. Data for the study were collected in Indonesia, from 43 finance providers and 434 horticultural farmers who cultivate mango, mangosteen, chili, and red onion.

Finance in Indonesia can be obtained from different finance providers: banks, MFIs, farmers' associations, traders and agricultural input kiosks. Banks and MFIs provide credit, whereas farmers' associations and traders provide in-kind finance, and agricultural input kiosks provide flexible payment for inputs.

The results show that the most important requirements to acquire finance vary among the finance providers. Although banks and MFIs both provide credit, they focus on different requirements. Banks perceive *character* in terms of the history of loan repayments, the *capacity* of farmers to pay back the loan, and *farmer ability* to manage their farms as very important requirements. MFIs focus on *character* and *spouse knowledge* of the finance application. Furthermore, to obtain in-kind finance, farmers' associations require farmers to have *membership* of a registered farmers' association, whereas traders perceive *farmer ability* and presence of a *sales contract* as the most important requirements. Agricultural input kiosks perceive the *character* of the farmer to be the most important requirement.

Overall, farmers have relatively little knowledge of the different requirements, which are important for each type of finance provider. The censored regression model shows that the factors influencing farmer knowledge of the requirements differ according to the type of finance provider. Farmer knowledge is positively associated with *finance experience*, especially for finance from farmers' associations. *Education level* and *farming experience* have significant associations with farmer knowledge of the requirements of at least one type of finance provider.

The results of this study can be used to design strategies to improve farmer knowledge of finance and subsequent access to finance. Awareness campaigns could improve farmers' opportunities to obtain finance by increasing farmer knowledge of the diversity of requirements among the finance providers. Involving farmers who already have experience with different sources of finance likely increases the success of such campaigns.

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Chapter 3

Performance and Finance Utilisation in Indonesian Horticulture

Eliana Wulandari [a b], Miranda P. M. Meuwissen [a], Maman H. Karmana [b], and Alfons G. J. M. Oude Lansink [a]

[a] Business Economics, Wageningen University, Wageningen, The Netherlands.

[b] Faculty of Agriculture, University of Padjadjaran, West Java, Indonesia

Accepted to be published in British Food Journal

Abstract

Finance is important for the development of agriculture and the farms' performance. The purpose of this study is to analyse the association between the technical efficiency of horticultural farms and finance utilisation from different finance providers. Data were collected from 434 farmers who produce mango, mangosteen, chili and red onion in Indonesia. Data were subsequently analysed using data envelopment analysis and bootstrap truncated regression. The results show that commercial credit from banks and in-kind finance provided through farmers' associations have a positive association with the technical efficiency of some types of horticultural farms. Commercial credit from MFIs and flexible payment of inputs to the agricultural input kiosks generally have negative associations, especially with the technical efficiency of mangosteen farms. Subsidised credit from banks and in-kind finance from traders have both positive and negative associations with the technical efficiency of the horticultural farms. This study adds to the existing literature by analysing utilisation of finance from a broader range of finance providers and its relation to technical efficiency.

Keywords: Horticulture, data envelopment analysis, bootstrap truncated regression

3.1 Introduction

Finance has been a major concern for policy makers in agriculture, especially in developing countries (Ammani 2012; Ugwumba and Omojola 2013). Previous studies have shown that limited access to finance hinders productivity growth in agriculture (Ammani 2012; Risilia et al. 2013), and that the availability of finance is much more important than any other factor for the efficient use of resources in the agricultural sector (Ayaz and Hussain 2011).

Farmers in developing countries obtain finance from different types of finance providers. For instance, farmers can apply for credit to finance their farms. Credit can be obtained from a wide variety of sources, including banks, moneylenders, relatives, cooperatives (Pham and Lensink 2007; Armendariz and Labie 2011), micro finance institutions (MFIs) (Kaino 2005; Bastin and Matteucci 2007) and various development programmes (Pham and Lensink 2007). In addition to credit, farmers can obtain finance through government subsidies. Subsidies, especially in developing countries, are provided for agricultural inputs, such as fertilizer and seeds, and for interest on credit (Dorward and Chirwa 2011, Wulandari et al. 2015).

Previous studies have found that farmers who obtained credit have better input markets and have a better performance (efficiency) than farmers who did not obtain credit (Carter 1989; Ahmad et al. 2002; Ammani 2012). The evidence on the effect of subsidies is more mixed. Dorward and Chirwa (2011) found that subsidies from government institutions contribute to productivity improvements. In contrast, Sedik et al. (1999) showed that granting subsidies lead to higher inefficiency in Russian agriculture. Similarly, Bezlepkina and Oude Lansink (2006) found that subsidies were negatively correlated with farm production in

Russia, because farmers were required to sell their products to the state at lower prices in return for the subsidy.

Although existing literature has investigated the impact of finance utilisation on the efficiency with which farms operate, this literature focuses mostly on finance obtained from banks and government. Very few studies have analysed the effect of finance utilisation from other sources. In this context, the objective of this study was to analyse the relation between the technical efficiency of horticultural farms in Indonesia and finance utilisation from different sources, including finance from banks, MFIs, farmers' associations, traders, agricultural input kiosks and other finance sources.

The results of the study provide insights to policy makers and finance providers about the role different sources of finance could play in improving the technical efficiency of farms. This study focuses on horticultural farms in Indonesia because horticulture is important for agricultural GDP and contributes to the growth of employment in agriculture (Centre for Agricultural Data and Information System 2012). The selected farms in this study are horticultural farms that produce mango, mangosteen, chili and red onion as the main crop.

The organisation of the remainder of this paper is as follows. The next section describes the finance sources available to horticultural farmers in Indonesia. This is followed by a description of the methodology. Section 3.4 describes the survey, the variables included in the technical efficiency model and the factors that could explain efficiency differences between farmers. The results are described in Section 3.5 and the final section concludes by discussing the results and policy implications.

3.2 Sources of finance for farmers in Indonesia

There are many sources of finance that can be accessed by horticultural farmers in Indonesia. Examples are banks, MFIs and other finance sources, such as friends or relatives (Machmud and Huda 2011). Farmers can also access finance from farmers' associations, traders and agricultural input kiosks (Wulandari et al. 2015).

Finance from banks. Farmers can access finance from banks by applying for commercial credit. Farmers can also apply for a subsidised credit programme, offered by banks collaborating with the Indonesian government; an example is the programme of micro credit loans (*KUR-Kredit Usaha Rakyat*). The KUR is designed to help farmers obtain credit, especially farmers who do not have any collateral (Agricultural Ministry of Indonesia 2013).

Finance from micro finance institutions. Farmers can also apply for commercial credit offered by MFIs. Farmers are required to register as a member of a MFI to obtain credit. Credit from MFIs benefit small farmers who cannot obtain credit from banks.

Finance from farmers' associations. Farmers' associations channel government aid for farmers who are members of the farmers' association. The Indonesian government provides the associations with cash aid through the rural agribusiness development programme (*PUAP-Pengembangan Usaha Agribisnis Perdesaan*), which targets farmers' associations as a means to motivate farmers to increase production. The government also provides the associations with seed and fertilizer, farm equipment and subsidies to purchase seed and fertilizer. The associations then distribute the finance obtained from the government to their members. Finance is provided in-kind, i.e. by distributing agricultural inputs to their members. In return, some farmers' associations require their members to sell their products to the farmers' association under the conditions set in the contract between association and members.

Finance from traders. Some traders provide in-kind finance to farmers with a sales contract, which is set by the traders and farmers together. In-kind finance can include seeds, fertilizers and pesticides. The contract specifies the rules for production, the amount of produce to be delivered and prices.

Finance from agricultural input kiosks. Finance is provided by some agricultural input kiosks to farmers by selling inputs, such as seed, fertilizer and pesticides, for a flexible payment. This means that farmers can pay for the input after purchase; the period for payment is usually between one week and one month after purchase. Some kiosks allow farmers to pay for the inputs after harvesting, as long as the farmers agree to sell the harvest to the kiosk.

Finance from other finance providers. Family and friends serve as *other finance providers*. Informal sources of finance are traditionally important for people in rural areas, as they supply short-term credit for the urgent demands of farming households, which are usually not met by the formal sector, such as banks and MFIs (Duong and Izumida 2002).

3.3 Research methods

This study used a two-stage methodology. In the first stage, data envelopment analysis (DEA) was used to estimate the technical efficiency of farms. In the second stage, a bootstrap truncated regression was conducted to determine the association between the technical efficiency and finance utilisation from different finance sources and other potential explanatory factors.

3.3.1 Data envelopment analysis: output-oriented DEA model

Technical efficiency was estimated using DEA. DEA is a non-parametric approach to estimate technical efficiency and is more flexible than a parametric approach, such as

stochastic frontier analysis, because it avoids assumptions about the specification of the production frontier and the distribution of efficiency (Oude Lansink et al. 2002). A non-parametric approach is particularly suitable for analysing production processes in developing countries, where the availability of data is limited and production technologies are generally less well understood (Brazdik 2006).

DEA, introduced by Charnes et al. (1978), is a linear programming methodology to measure the efficiency of decision making units. DEA uses data on input and output quantities to construct a piece-wise linear surface over the data points. This frontier surface is constructed by the solution of a sequence of linear programming problems (Coelli and Rao 2005). Technical efficiency is defined in this study as the potential to increase output from a given set of inputs (Farrell 1957). This study uses an output orientation to analyse technical efficiency because inputs are generally the constrained factors in the Indonesian context. In the output-oriented case, the DEA method seeks the maximum proportional increase in output production, with input levels held fixed (Coelli and Rao 2005). The output-oriented technical efficiency under constant returns to scale is obtained by solving the following linear programming problem:

$$\max_{\theta,\lambda} \theta \qquad (1)$$

Subject to :

$$\theta_i y_i \leq \lambda Y$$

$$x_i \geq \lambda X$$

where $1/\theta_i$ is the technical efficiency score ($1/\theta \in [0,1]$) for the i^{th} farmer, X and Y are vectors of inputs and outputs, and λ is a vector of weights that indicate the level of importance of each input or output.

To obtain a robust DEA measurement, the bootstrap methodology developed by Simar and Wilson (2007) was used. Simar and Wilson showed that their bootstrap method gives more stable estimates and can accommodate bias correction of efficiencies. Simar and Wilson (1998) also showed that it is easy to analyse the sensitivity of efficiency scores relative to the sampling variations of the estimated frontier using the bootstrap method. The R programming language, in combination with the statistical software package FEAR of Wilson (2008), was used to compute the bootstrapped technical efficiency score.

3.3.2 Bootstrap truncated model

In the second stage, the estimated bias-corrected technical efficiency scores were regressed on financial and socio-economic factors. Simar and Wilson (2007) showed that conventional estimators fail to deal with the problem that DEA efficiency estimates are serially correlated in the second-stage regression. They introduced a bootstrap truncated regression model that solves the problem of serial correlation in truncated regression.

To determine the association between technical efficiency and finance utilisation, STATA package was used for the second-stage truncated regression, applying the bootstrap method using 2000 replications, as suggested by Simar and Wilson (2007). The bootstrap truncated regression model to explain the relation between technical efficiency and finance utilisation is expressed as follows:

$$1/\theta_i = \beta Z_i + \varepsilon_i \qquad (2)$$

where the dependent variable $1/\theta_i$ is the bootstrapped technical efficiency score, and Z reflects the environmental variables that could be related with technical efficiency, i.e. financial and socio-economic factors. Prior to the regression, all the environmental variables except dummy variables were standardised to prevent scale effects of the β coefficients. Furthermore,

multicollinearity was tested by calculating the Variance Inflation Factors (VIF) for each variable. When the problem of multicollinearity was found, then the problem was corrected by removing variables that have VIF values of more than 10. A model is free from multicollinearity problem when the VIF of all variables are below 10 (Rook et al. 1990).

3.4 Data

3.4.1 Survey

Questionnaire design. Structured questionnaires for farmers were prepared to collect the data needed to measure technical efficiency (first stage) and to explain technical efficiency (second stage). The questionnaire was pre-tested to evaluate consistency, clarity and to avoid duplicate questions. The questions covered three main areas: socio-economic characteristics of farmers, the experience of farmers in obtaining finance from different sources during 2013, and quantities of farm outputs produced and variable inputs used in 2013.

Data collection. Data were collected in person from January 2014 to July 2014 using structured survey methods. Most farmers in Indonesia cultivate more than one crop on their farms and this was also the case in this sample. Data were collected from farmers who cultivate one of the four selected crops as their main output. The selected crops are mango, mangosteen, chili and red onion; these crops are identified by the Indonesian ministry of agriculture as key crops for horticultural development in Indonesia (Agricultural Ministry of Indonesia 2011). The 434 farmers that were surveyed were selected from the main areas of horticultural production, i.e. West Java, Central Java and East Java. The selection procedure is explained in the following paragraphs.

Within Java, study sites were selected based on the importance of horticultural production, especially for the selected crops. Java is divided into provinces. Firstly, two

provinces were selected as study sites for each selected crop, based on the largest production area and the potential to develop the selected crop. According to data from the Central Bureau of Statistics in Indonesia (BPS, 2013), production of mango occurs mainly in West Java and East Java, and the production of chili, red onion and mangosteen occurs mainly in West Java and Central Java.

Next, for each province, districts with the highest production during the last five years were selected. For mango, the chosen districts were Cirebon and Indramayu (West Java), and Probolinggo and Pasuruan (East Java). The chosen districts for mangosteen were Tasikmalaya and Subang (West Java), and Purworejo (Central Java). For chili, selected districts were Garut, Tasikmalaya and Ciamis (West Java), and Pemalang and Purbalingga (Central Java). Finally, the selected districts for red onion were Majalengka and Bandung (West Java), and Brebes (Central Java).

Farmers were then randomly selected in each district, based on farm address data obtained from agricultural officers and personal contacts. The sample contained 434 farmers who were grouped according to their main crop: 101 producing mango, 103 producing mangosteen, 123 producing chili and 107 producing red onion.

3.4.2 Data for DEA model

Data on one output and four inputs was used to measure technical efficiency. The output variable was the revenue of crops production and the four inputs were land, labour, variable costs and capital. The revenue of crops production was measured as the revenue of all crops produced by a farmer, including the main crop and additional crops. The main crop was the crop that generated the highest revenue among all the crops produced by the farmer; the farmers were grouped according to this main crop.

Land was measured as the size of the area used by a farmer for producing crops. The cost of labour was computed by multiplying the hours worked by the price of labour. The cost of own labour for the farmer was calculated using the price of hired labour.

The variable costs were measured as the expenditure on seeds, fertilizer, pesticides, land rent and water for irrigation, and the purchase of temporary (disposable) equipment. Capital was defined as the value of owned farm equipment, measured by the replacement value of agricultural machinery owned by the farmer. All variables except land were measured as total annual expenditure and expressed in 2013 Indonesian Rupiahs (IDR). Land was measured in hectares. Table 3.1 presents mean values for all output and input variables per sector (main crop) and finance provider.

The difference in output and input variables between farmers who obtained finance and those who did not was tested using an independent sample t-test. Results of the t-test show that, overall, most significant differences between the input and output variables occurred for farmers who obtained commercial and subsidised credit from banks, and for farmers who obtained in-kind finance from farmers' associations and traders. For instance, mango farmers who obtained commercial credit from a bank have significantly higher output and input quantities, except labour, than mango farmers with no commercial credit. In contrast, chili farmers who obtained subsidised credit from a bank have significantly lower land, labour expenses and capital compared to the chili farmers with no subsidised credit. Furthermore, the larger chili farmers, in terms of higher revenue, labour expenses and capital, have more in-kind finance from farmers' associations.

Table 3.1 Mean values for output and input variables used in the DEA analysis, for the sample of horticultural farmers grouped by main crop

Variables	Unit	Crop	Bank				MFI		Farmers' association		Trader		Kiosk		Other	
			Commercial credit		Subsidised credit		Commercial credit		In-kind finance		In-kind finance		Flexible payment		Other	
			1	0	1	0	1	0	1	0	1	0	1	0	1	0
Output:																
Revenue of crops production	million IDR	Mango	162.00*	29.30	78.65	51.26	20.62	54.22	97.48*	38.22	123.00	46.05	178.69	42.07	66.11	42.26
		Mangosteen	23.50	17.90	-	18.60	13.90	19.20	15.50	20.60	36.40*	17.70	14.30	18.60	23.60	17.80
		Chili	172.00	117.00	61.80	150.00	31.00	121.00	248.00*	95.60	152.00	96.10	149.00	112.00	178.00	95.10
		Red Onion	233.00	72.00	-	90.10	143.00	85.30	112.00	83.40	34.00	94.10	84.60	94.20	104.00	86.00
Inputs:																
Land	hectares	Mango	4.42*	0.62	1.68	1.27	2.11	1.26	2.38*	0.94	2.26	1.20	5.46	0.94	1.29	1.30
		Mangosteen	0.79	0.89	-	0.87	1.14	0.84	0.97	0.81	1.24	0.86	1.00	0.87	0.82	0.88
		Chili	1.59	1.18	0.61*	1.51	0.49	1.22	2.72	0.92	1.67	0.86	1.75	1.06	1.44	1.10
		Red Onion	1.83	0.55	-	0.69	0.77	0.68	0.72	0.68	0.32	0.72	0.67	0.71	0.93	0.62
Labour expenses, including family	million IDR	Mango	55.38	5.89	14.54	14.72	3.70	15.16	19.96	12.98	21.32	14.06	27.04	13.65	11.14	17.57
		Mangosteen	6.42	5.31	-	5.45	6.30	5.35	4.90	5.81	7.52	5.35	10.00	5.41	5.88	5.39
		Chili	31.50	25.70	17.50*	30.60	11.90	26.30	54.80*	20.70	34.40	20.00	30.80	24.80	31.00	23.90
		Red Onion	51.90	20.50	-	24.00	70.80	19.70	38.10	19.70	11.10	24.90	21.40	25.90	24.20	23.90
Variable costs	million IDR	Mango	96.65*	6.99	10.20	23.78	4.00	23.75	25.12	22.26	75.58	17.82	56.16	20.12	18.30	26.72
		Mangosteen	2.03	1.69	-	1.73	1.18	1.80	2.26	1.40	2.45	1.70	8.50	1.67	3.58	1.44
		Chili	96.00	39.80	28.90	49.80	16.50	43.20	68.70	37.70	60.30*	29.90	45.30	41.80	60.50	35.10
		Red Onion	158.00	37.80	-	51.30	57.00	50.70	54.10	50.40	15.20	53.80	53.40	49.70	73.00	44.60
Capital	million IDR	Mango	10.03*	2.69	6.13	3.86	1.67	4.09	7.62*	2.80	8.96*	3.51	9.69*	3.50	4.32	3.73
		Mangosteen	0.78	0.72	-	0.73	0.59	0.75	0.89	0.62	0.84	0.72	0.76	0.73	0.69	0.73
		Chili	6.77	5.22	2.49*	6.80	11.40	5.14	14.80*	3.56	8.47*	3.05	6.62	4.96	5.45	5.23
		Red Onion	4.24*	2.20	-	2.43	4.94*	2.20	2.27	2.48	1.03*	2.53	2.22	2.58	1.90	2.59

Note: USD 1 in 2013= IDR 10,445. 1= respondents obtained finance in 2013 from this finance provider; 0= otherwise.
*Difference between the means of the two groups is statistically significant at 5% level.
Source: Authors' calculation

3.4.3 Data for bootstrap truncated model

This study considered a range of financial and socio-economic variables as factors explaining technical efficiency. Financial factors were represented by seven dummy variables, each of which refers to whether a farmer obtained this type of finance during 2013: commercial credit from a bank (*commercial credit*), subsidised credit from a bank collaborating with the government (*subsidised credit*), credit from a MFI (*mfi*), in-kind finance from a farmers' association (*farmers' association*), trader (*trader*) and agricultural input kiosk (*kiosk*), and other sources of finance (*other*), such as family and friends. If a farmer obtained finance from more than one source, each type of finance was counted. For instance, if a farmer obtained finance from a farmers' association, an agricultural input kiosk and a friend, then the dummy variables *farmers' association*, *kiosk* and *other* all had a value of one for this farmer.

The different types of finance sources, except subsidised credit from a bank, are all expected to have a positive relation with the technical efficiency of farms, because finance can provide better access to inputs and technologies. Previous studies on finance have shown that having commercial credit from a bank (Zhengfei and Oude Lansink 2006) or MFI (Girabi and Mwakaje 2013) improves access to inputs and agricultural technologies. Studies have also shown that in-kind finance, such as being a member of a village association (Lamprinopoulou et al. 2006) or having a contract with trader (Schipmann and Qaim 2011), can improve access to agricultural inputs. Farmers need to buy agricultural inputs during the planting and growth periods (Binam et al. 2004), therefore flexible payments for inputs offered by agricultural input kiosks and finance from other sources may enhance farmers' opportunity to obtain agricultural inputs for farmers. In addition to these positive associations, however, subsidised credit may have a negative association with technical efficiency if farmers spend the money on other activities. For instance, Riaz et al. (2012) found that

farmers did not use credit for crop purposes but for other activities, such as household needs, construction of a house and other purposes, thereby lowering overall farm production.

A review of efficiency studies in developing countries (Bravo-Ureta and Pinheiro 1993) showed that in addition to credit, other socio-economic variables, such as education and farming experience, are frequently used to explain technical efficiency. Based on literature, five socio-economic variables were included as additional explanatory factors for technical efficiency: education, farming experience, age, infrastructure and distance to an agricultural input kiosk. Education (*educ*) is measured as the formal education of a farmer in years. Education is expected to positively relate to efficiency because educated farmers usually have better access to information about the use of technology on their farms (Ahmad et al. 2002). Farming experience (*fexp*) is measured as the number of years of experience in managing a farm. Farming experience is expected to positively affect technical efficiency because experienced farmers have more knowledge about their farms and farming practices (Ayaz and Hussain 2011). Age (*age*) is measured as the age of the farmer in years and is expected to have a positive relation with technical efficiency, as older farmers focus on improving efficiency, especially after investment and expansion (Zhengfei and Oude Lansink 2006). Infrastructure (*infrastructure*) is a dummy variable representing the quality of roads, with a value of one indicating good roads. Good roads are expected to have a positive association with technical efficiency, whereas poor roads cause higher transport costs, which may lead to lower efficiency (Chianu et al. 2008). Distance to an agricultural input kiosk (*distance*) is a variable representing the distance to input markets and is measured as the distance from a farmer's house to the nearest agricultural input kiosk (in kilometres). Distance to the kiosk is expected to have a negative association with technical efficiency because access to input markets is very effective in increasing efficiency (Rachmina et al. 2014).

The definitions and summary statistics of all the explanatory variables included in the model are presented in Table 3.2. The table shows that a large percentage (28%) of farmers in the sample obtained finance from other sources, such as family and friends. The average age of the farmers was 47 years, with an average of eight years of formal education; on average, chili farmers were the youngest farmers. The farmers had an average of 24 years of farming experience. Table 3.2 also shows that finance obtained from different finance sources varies among the groups of farmers. Almost half of mango farmers (45%) obtained finance from other sources, such as family and friends; whereas 42% of red onion farmers obtained finance from agricultural input kiosks and 41% of chili farmers obtained finance from traders. A large percentage of mangosteen farmers obtained in-kind finance from farmers' associations (39%).

Table 3.2 Definitions and mean values (standard deviations in parentheses) for the explanatory variables used in the bootstrap truncated regression for the sample of horticultural farmers, grouped by main crop (n=434)

Variables		Variable definition	Mango (n=101)	Mangosteen (n=103)	Chili (n=123)	Red Onion (n=107)	Overall (n=434)
Bank	Commercial credit	1: obtained commercial credit from bank in 2013	0.18 (0.04)	0.13 (0.03)	0.05 (0.02)	0.11 (0.03)	0.11 (0.02)
	Subsidised credit	1: obtained subsidised credit from bank in 2013	0.06 (0.02)	-	0.35 (0.04)	-	0.11 (0.02)
MFI		1: obtained commercial credit from MFI in 2013	0.04 (0.02)	0.11 (0.03)	0.02 (0.01)	0.08 (0.03)	0.06 (0.01)
Farmers' association		1: obtained in-kind finance from farmers' association in 2013	0.25 (0.04)	0.39 (0.05)	0.15 (0.03)	0.23 (0.04)	0.25 (0.02)
Trader		1: obtained in-kind finance from trader in 2013	0.09 (0.03)	0.05 (0.02)	0.41 (0.04)	0.07 (0.02)	0.17 (0.02)
Kiosk		1: obtained flexible payment to inputs from agricultural input kiosk in 2013	0.08 (0.03)	0.01 (0.01)	0.20 (0.04)	0.42 (0.05)	0.18 (0.02)
Other		1: obtained finance from other finance sources in 2013	0.45 (0.05)	0.14 (0.03)	0.30 (0.04)	0.23 (0.04)	0.28 (0.02)
Age		Age (years)	46 (0.93)	53 (1.11)	41 (0.91)	49 (0.91)	47 (0.52)
Education		Formal education (years)	9 (0.25)	8 (0.26)	8 (0.25)	7 (0.22)	8 (0.13)
Farming experience		Experience in managing own farm (years)	23 (1.13)	31 (1.42)	15 (0.86)	28 (1.17)	24 (0.64)
Infrastructure		1: good roads	0.48 (0.05)	0.38 (0.05)	0.25 (0.04)	0.49 (0.05)	0.39 (0.02)
Distance		Distance from house to agricultural input kiosk (kilometres)	3.38 (0.29)	3.82 (0.32)	2.07 (0.17)	1.13 (0.11)	2.56 (0.13)

Source: Authors' calculation

3.5 Results and discussion

3.5.1 Technical efficiency of different groups of horticultural farms

Table 3.3 shows that the average bias-corrected technical efficiency is low for all groups of farms. The highest bias-corrected technical efficiency is found for red onion farms (59%); the estimate implies that production can increase by as much as 41% while using the same quantities of inputs. The lowest bias-corrected technical efficiency is found for chili farms (37%) and shows that chili farmers can increase their production by as much as 63% while using the same quantity of production factors. The bias-corrected technical efficiency is 45% for mango farms and 56% for mangosteen farms. The 95% confidence intervals shown in Table 3.3, indicate that there is no significant difference between the technical efficiencies of the groups of farms, as grouped by main crop.

Table 3.3 Mean values for technical efficiency and bias-corrected technical efficiency, and 95% confidence intervals for technical efficiency for horticultural farmers in the sample, grouped by main crop

Crop	Technical efficiency	Bias-corrected technical efficiency	95% Confidence Interval	
			Lower bound	Upper bound
Mango	0.61	0.45	0.02	0.98
Mangosteen	0.68	0.56	0.02	0.99
Chili	0.48	0.37	0.03	0.96
Red Onion	0.70	0.59	0.13	0.99

Source: Authors' calculation

To the best of the authors knowledge, no previous literature is available on the technical efficiency of mangosteen farms, but a comparison can be made for the other crops. For instance, the mean technical efficiency of perennial crops, including mango, in Ethiopia was 25% (Makombe et al. 2011). Another study (Mar et al. 2013) found that the mean technical efficiency of mango farms in Myanmar was 71%, with a range from 27% to 87%. Although

some of the computed technical efficiency scores of mango farms found in this study are relatively low (range from 2% to 98%), the others are still within the range of values found by other studies. A potential explanation for some of the very low technical efficiency scores of mango farms is because they are not specialized mango farms, as there were other crops grown in the same area with mango farms.

The mean technical efficiency of chili farmers in South-West Nigeria was 74%, with a range from 17% to 92% (Dipeolu and Akinbode 2012). Chili farmers in Bangladesh also had similar efficiencies, with a mean technical efficiency of 77% and a range from 11% to 96% (Anwarul Huq and Arshad 2010). The range of technical efficiency scores of chili farms in this study is 3% to 96%, which is within the range found in other studies.

With regard to red onion farming, a study in Brebes, Indonesia, found that the mean technical efficiency of red onion farms was 80%, with minimum and maximum values of 65% and 100% (Banani et al. 2013). A study in Nganjuk, Indonesia (Waryanto et al. 2014) found that the mean technical efficiency of red onion farms was 61%, with a range from 8% to 100%. The technical efficiency of red onion farms found in this study ranges from 13% to 99%, which is within the range found in previous studies.

3.5.2 Factors determining the technical efficiency of horticultural farms

The results of the bootstrap truncated regression to determine factors that are associated with the technical efficiency of horticultural farms are presented in Table 3.4. The results show that the relation between technical efficiency and finance utilisation from different finance providers varies among the groups of farms. Commercial credit has a positive association with the technical efficiency of mangosteen and red onion farms. The positive association is consistent with prior expectation and the results of Zhengfei and Oude Lansink (2006). A contrasting effect for subsidised credit was found, consistent with the literature.

Subsidised credit positively associates with the technical efficiency of mango farms and negatively associates with the efficiency of chili farms. The positive association is in line with the results of Taylor and Shonkwiler (1986). The negative association is consistent with other studies that have shown that subsidised credit can lead to a decrease technical efficiency (Brummer and Loy 2000; Rezitis et al. 2003). Contrary to prior expectation, finance from MFI negatively associates with the technical efficiency of mangosteen farms. A possible explanation might be that finance utilisation does not cause inefficiency, but the effect arises because the MFI specially targets smaller mangosteen farmers in terms of less capital (Table 3.1). A study of Aliero and Ibrahim (2012) showed that a finance programme targeted poor farmers for reducing poverty in rural areas.

Finance from a farmers' association has a positive association with the technical efficiency of chili and red onion farms. The positive association might be because the application procedure includes a strict assessment of the agribusiness plan made by farmers (Agricultural Ministry of Indonesia 2011); a good business plan may represent good farm management, which results in higher technical efficiency. The results show a contrasting effect for finance utilisation from traders: a positive association with the technical efficiency of mangosteen farms and a negative association with the technical efficiency of chili farms. The negative effect for chili farms might be attributable to the slow response of traders to requests from farmers for pesticides. A slow response is particularly problematic for sensitive crops, such as chili, as diseases can easily lead to substantial yield losses (Albajes et al. 2002).

Finance from the agricultural input kiosk is negatively related with the technical efficiency of mangosteen farms. As shown in Table 3.1, mangosteen farmers who obtained finance from an input kiosk have higher labour costs and variable costs, such as fertilizer and pesticides, and lower revenues than those who did not obtain finance from the kiosk. This suggests that farmers who obtain finance from kiosks may be using more inputs than

necessary. As explained by Iraizoz et al. (2003), farmers who use more inputs than necessary are less efficient. Finance from other sources is positively associated with the technical efficiency of all the farms, but the association is not statistically significant.

Table 3.4 Coefficients from the bootstrap truncated regression of bias-corrected technical efficiency on the explanatory factors, standard errors in parentheses

Variables		Mango (n=101)	Mangosteen (n=103)	Chili (n=123)	Red Onion (n=107)
Constant		0.380	0.550	0.438	0.559
		(0.052)	(0.041)	(0.048)	(0.036)
Bank	Commercial credit [a]	-0.043	0.190***	-0.005	0.146***
		(0.061)	(0.075)	(0.155)	(0.059)
	Subsidised credit [a]	0.188*	-	-0.195***	-
		(0.115)	(-)	(0.070)	(-)
MFI [a]		-0.133	-0.231***	-0.112	0.060
		(0.116)	(0.088)	(0.074)	(0.068)
Farmers' association [a]		-0.085	-0.037	0.155**	0.191***
		(0.061)	(0.056)	(0.066)	(0.039)
Trader [a]		0.048	0.131**	-0.128**	-0.004
		(0.129)	(0.060)	(0.061)	(0.081)
Kiosk [a]		0.002	-0.493***	-0.058	-0.045
		(0.130)	(0.071)	(0.069)	(0.038)
Others [a]		0.012	0.094	0.060	0.037
		(0.055)	(0.060)	(0.059)	(0.051)
Age (years)		0.004	0.042	-0.002	0.024
		(0.042)	(0.046)	(0.026)	(0.030)
Education (years)		-0.053*	-0.024	0.027	-0.022
		(0.028)	(0.028)	(0.024)	(0.019)
Farming experience (years)		-0.077**	-0.058	0.001	-0.046
		(0.036)	(0.044)	(0.026)	(0.029)
Infrastructure [b]		0.147***	0.024	-0.014	-0.041
		(0.055)	(0.057)	(0.056)	(0.040)
Distance (kilometres)		-0.024	-0.005	-0.062**	0.010
		(0.025)	(0.028)	(0.031)	(0.026)

*** Significant at 1%, ** 5%, and * 10% level
[a] Dummy variable representing whether the respondent obtained finance from the finance provider in 2013; 1 if yes, 0 otherwise.
[b] Dummy variable representing the quality of road infrastructure; 1 if good roads, 0 otherwise.
Source: Authors' calculation

Overall, the socio-economic factors included in the bootstrap truncated regression have few significant effects on the efficiency of farms in the sample. Age is not significantly

associated with the efficiency of any of the groups, whereas the other variables are significantly associated with the efficiency of only one group of farmers. In contrast to prior expectation, education negatively associates with the technical efficiency of mango farms. A possible explanation for this finding is that lower-educated farmers have fewer opportunities for off-farm employment, which induces them to focus on improving efficiency, whereas higher-educated farmers tend to have off-farm jobs (Reardon et al. 2001), potentially implying that farming is a side-activity. Similarly, the association between the technical efficiency of mango farms and farming experience contradicts with the prior hypothesis that efficiency increases with farming experience. This might be because some respondents in this study became farmers again after temporary migration. For these farmers, farming experience might be somewhat overestimated, as remaining household members generally continue farming, but not as their main activity (Jokisch 2002).

Distance from a farmer's house to the agricultural input kiosk negatively associates with the technical efficiency of chili farms, consistent with prior expectation and the results of Rachmina et al. (2014). Good road infrastructure has a positive association with the technical efficiency of mango farms, which implies that the technical efficiency of mango farms is higher, ceteris paribus, for farmers who have good roads in the proximity of the farm. A study of Chianu et al. (2008) suggested that improving roads is a way to decrease transport costs, leading to a higher technical efficiency.

2.3 Conclusions and policy implications

Data were analysed from a survey of 434 horticultural farmers in Indonesia, who produced mango, mangosteen, chili and red onion as their main crop. The objective of this study was to analyse the association between the technical efficiency of the selected

horticultural farms and finance utilisation from different sources, including finance from banks, MFIs, farmers' associations, traders, agricultural input kiosks and other finance sources, such as family and friends. The results show that the farms in the sample have a relatively low technical efficiency; average technical efficiency ranges from 37% (chili farms) to 59% (red onion farms).

Although banks and MFIs both provide commercial credit, the results indicate that the association of commercial credit utilisation with technical efficiency differs for banks and MFIs. Whereas commercial credit from banks positively associates with the technical efficiency of some types of horticultural farms, commercial credit from MFIs has a different effect. The utilisation of commercial credit from MFIs generally has a negative association with technical efficiency, especially for mangosteen farms.

With regard to in-kind finance, finance utilisation from farmers' associations has a significant and positive association with the technical efficiency of chili and red onion farms, whereas in-kind finance from traders shows both positive and negative significant associations with efficiency. Finance utilisation from the agricultural input kiosk negatively associates with the technical efficiency of mangosteen farms. Finance utilisation from other sources, such as family and friends, does not significantly associate with the technical efficiency of any of the types of farms.

The expected effects of the socio-economic variables on farm efficiency could generally not be confirmed, with a few exceptions. For instance, proximity of agricultural input kiosks positively affects the efficiency of chili farms and good road infrastructure positively affects the efficiency of mango farms.

The results of this study imply that policies, which aim to enhance farm development through the provision of agricultural finance, seem more promising when focusing on commercial credit provided by banks and in-kind finance provided by farmers' associations.

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Chapter 4

The Role of Finance Utilisation from Different Finance Providers in Production Risks of Horticulture in Indonesia

Eliana Wulandari[a b], Miranda P. M. Meuwissen[a], Maman H. Karmana[b], and Alfons G. J. M. Oude Lansink[a]

[a] Business Economics, Wageningen University, Wageningen, The Netherlands.

[b] Faculty of Agriculture, University of Padjadjaran, West Java, Indonesia

Submitted for publication

Abstract

Finance is important to minimise production risk in agriculture. This study analysed the relation between production risk of horticultural farms and finance utilisation from different finance providers, such as banks, micro finance institutions, farmers' associations, traders, agricultural input kiosks and other finance sources. Production risk was measured by the coefficient of variation, skewness, kurtosis and the 25th percentile. Data were collected from 434 farmers who produce mango, mangosteen, chili and red onion in Indonesia. The results show that the relation between finance utilisation and production risk differs across the finance providers. Depending on the risk measure, risk-reducing relations were found for commercial credit from banks and flexible payments of inputs to kiosks. In contrast, the results did not show any risk reduction associated with finance provided by farmers' associations or so-called "other sources", such as family and friends. Findings suggest that public and private finance programmes for agriculture may need to prioritise finance from commercial banks and input kiosks, as these seem better equipped to provide incentives for risk reduction.

Keywords: Horticulture, coefficient of variation, skewness, kurtosis, 25th percentile, Indonesia.

4.1 Introduction

Production risk is an important issue for policy makers, finance providers and supply chain actors in agriculture, such as farmers and traders. Production risk is especially important in developing countries. Risk exists in agricultural production because of the high variability of production that cannot be certainly predicted by farmers (Hardaker et al. 2015). Previous studies have shown that production risk has a large impact on the decision to invest in farm technology (Ogada et al. 2010), which in turn affects food production and therefore food security (Feleke et al. 2010; Tester and Langridge 2010).

Studies have shown that production risk can be reduced by undertaking activities that increase yields; these activities can be facilitated by proper access to finance (Angelucci and Conforti 2010; Wossen et al. 2014). For instance, farmers who obtain credit can invest in irrigated land, which can reduce the effects of climate variability and therefore reduce production risk (Wossen et al. 2014). Furthermore, credit can be used to purchase inputs that can decrease production risk, such as feeds, fertilizer, insecticides and fungicides (Angelucci and Conforti 2010).

Finance can be accessed from different types of finance providers; these providers generally facilitate access to different agricultural inputs. For example, credit can be used to buy agricultural inputs and improved technologies (Girabi and Mwakaje 2013). Credit can be obtained from a variety of sources including banks, moneylenders, relatives, cooperatives (Pham and Lensink 2007; Armendariz and Labie 2011), micro finance institutions (MFIs) (Kaino 2005; Bastin and Matteucci 2007) and various development programmes (Pham and Lensink 2007). Farmers can also obtain finance through government subsidies. Subsidies, especially in developing countries, are provided for agricultural inputs, such as fertilizer and seeds, and for interest payments on credit (Dorward and Chirwa 2011, Wulandari et al. 2015).

In-kind finance, such as fertilizers and seeds, has been provided by a village association (Lamprinopoulou et al. 2011) and traders (Schipmann and Qaim 2011; Pandit et al. 2015).

Despite the importance of finance utilisation in reducing production risk, to the best of the authors' knowledge, no studies have analysed the effect on production risk of utilisation of finance from different sources. In this context, this study aims to analyse the effect of finance utilisation from different finance providers on production risk in Indonesia. Finance providers included in the study are banks, MFIs, farmers' associations, traders, agricultural input kiosks and other finance sources. Results of the study provide insight into the role of finance utilisation from different finance sources in minimising production risk, especially in developing countries such as Indonesia. This information is useful for policy makers, finance providers and supply chain actors in agriculture. For policy makers, the results of this study can help in designing policy to enhance farmers' opportunity to obtain finance; whereas finance providers and supply chain actors, such as traders, obtain insight into whether their financial provisions effectively reduce production risk. This study focuses on horticultural farmers because horticulture is important for agricultural GDP and the growth of employment in agriculture in Indonesia (Centre for Agricultural Data and Information System 2012).

Production risk is an important issue in Indonesia. Production risk, among other reasons, has led to a decline in the number of farm households, which could affect agricultural production in Indonesia (Insyafiah and Wardhani 2014), and therefore food security in Indonesia (Darwanto 2005). Factors affecting production risk include climate factors, such as extreme rainfall (Purnamasari et al. 2002; Lamusa 2010; Offayana et al. 2016), pests and diseases, labour, and the quality of seeds (Offayana et al. 2016).

This paper proceeds with a description of finance sources available to farmers in Indonesia. This is followed by a description of the methods and variables used. Section 4.4 presents the results for the measures of production risk and the effects of the explanatory

variables on these measures. Finally, the paper discusses the results and provides policy implications.

4.2 Sources of finance for farmers in Indonesia

Finance can be accessed by Indonesian farmers from many different sources. Credit is supplied by banks and MFIs, and also others sources, such as friends or relatives (Machmud and Huda 2011). In-kind finance is provided by farmers' associations and traders, whereas agricultural input kiosks offer a scheme of flexible payments for inputs (Wulandari et al. 2015).

Finance from banks. Banks provide commercial credit and some banks also provide a subsidised credit programme. This is offered by banks collaborating with the Indonesian government. An example is the programme of micro credit loans (*KUR-Kredit Usaha Rakyat*). The KUR targets farmers who do not have any collateral (Agricultural Ministry of Indonesia 2013).

Finance from micro finance institutions. MFIs also provide commercial credit to farmers, especially small farmers who cannot obtain credit from banks. Farmers are required to register as a member of a MFI in order to obtain credit.

Finance from farmers' associations. Farmers who are members of a farmers' association can obtain finance from the association. The Indonesian government provides the associations with cash aid through the rural agribusiness development programme (*PUAP-Pengembangan Usaha Agribisnis Perdesaan*). This programme aims to motivate farmers to increase production by targeting farmers associations. The government also provides the associations with seed and fertilizer, farm equipment, and subsidies to purchase seed and fertilizer. The agricultural inputs obtained from the government are distributed as in-kind

finance to the association members. In return, some farmers' associations require members to sell their products to the farmers' association under the conditions set in the contract between association and members.

Finance from traders. Some traders provide in-kind finance to farmers who have a sales contract with the trader. These contracts are set by the traders and farmers together. In-kind finance can include seeds, fertilizers and pesticides. The contract specifies the rules for production, such as cultivation procedures, the amount of produce to be delivered, and prices.

Finance from agricultural input kiosks. Some agricultural input kiosks provide finance to farmers by selling inputs for a flexible payment. Inputs include seed, fertilizer and pesticides. The flexible payment enables farmers to pay for the input after purchase; the period for payment is usually between one week and one month after purchase. Some kiosks allow farmers to pay for the inputs after harvesting, as long as the farmers agree to sell the harvest to the kiosk.

Finance from other finance providers. Family and friends serve as *other finance providers*. Informal sources of finance are traditionally important for people in rural areas, as they supply short-term credit for the urgent demands of farming households. These urgent demands are usually not met by the formal sector, such as banks and MFIs (Duong and Izumida 2002).

4.3 Research methods

4.3.1 Survey of farmers

Questionnaire design. To measure production risk and finance utilisation, structured questionnaires for farmers were prepared and pre-tested to evaluate consistency and clarity,

and to avoid duplicate questions. The questions covered two main areas: an assessment of perceived yields and previous finance obtained from different sources.

Data collection. The survey was conducted from January 2014 to July 2014. Data were collected in person from farmers who cultivate one of the four selected crops as their main output. The selected crops were mango, mangosteen, chili and red onion; these crops are identified by the Agricultural Ministry of Indonesia as key crops for horticultural development in Indonesia (Agricultural Ministry of Indonesia 2011). The 434 farmers who were surveyed were selected from the main areas of horticultural production, i.e. West Java, Central Java and East Java. The selection procedure is explained in the following paragraphs.

Within Java, study sites were selected based on the importance of horticultural production, especially for the selected crops. Java is divided into provinces. Firstly, two provinces were selected as study sites for each selected crop, based on the largest production area and the potential to develop the selected crop. According to data from the Central Bureau of Statistics in Indonesia (BPS 2013), production of mango occurs mainly in West Java and East Java, and the production of chili, red onion and mangosteen occurs mainly in West Java and Central Java.

Next, for each province, districts with the highest production during the last five years were selected. For mango, the chosen districts were Cirebon and Indramayu (West Java), and Probolinggo and Pasuruan (East Java). The chosen districts for mangosteen were Tasikmalaya and Subang (West Java), and Purworejo (Central Java). For chili, selected districts were Garut, Tasikmalaya and Ciamis (West Java), and Pemalang and Purbalingga (Central Java). Finally, the selected districts for red onion were Majalengka and Bandung (West Java), and Brebes (Central Java).

Farmers were then randomly selected in each district, based on farm address data obtained from agricultural officers and personal contacts. The sample contained 434 farmers

who were grouped according to their main crop: 101 producing mango, 103 producing mangosteen, 123 producing chili and 107 producing red onion.

4.4 Analytical methods

4.4.1 Elicitation of perceived yields

Historical data on farm yields was unavailable for individual farmers. Therefore, the elicitation of perceived yields were selected, an approach also used by Ghadim and Pannell (2003). First, the farmers were asked about the lowest and highest perceived yields that could be obtained in the next five years, given the current use of inputs, finance obtained from a particular finance provider, disease pressure and physical growth conditions. Yields were specified in kilograms per hectare. Next, the range of the perceived yields was divided equally into seven intervals. Then, 20 coins were given to the farmers, with each coin representing a 0.05 probability. Farmers were asked to distribute all the coins over the seven intervals, in accordance with their expectation of the likelihood of obtaining the yield represented by each interval. All the farmers were able to perform the elicitation task assisted by an interviewer. The descriptive statistics of the perceived yields are presented in Appendix, Table 4.A.

4.4.2 Measurement of production risk

To measure production risk, four measures of risk were used, i.e. the coefficient of variation (CV), skewness, kurtosis and the 25^{th} percentile. The first three measure the shape of the yield distribution, whereas the 25^{th} percentile measures an absolute value of the distribution. The CV was chosen to represent production risk because it measures the variability of the data. The higher the CV, the higher the variability of the yields. Skewness measures the asymmetry distribution of a dataset. Positive skewness indicates a longer right

tail, and negative skewness indicates that the data are skewed to the left of the mean (Vose 2008). Kurtosis measures the peak of a distribution compared to the normal distribution, which has a kurtosis of three (Vose 2008). A higher kurtosis indicates that the distribution becomes narrower, which indicates lower production risk.

The last measure of risk used in this paper was the 25th percentile, which measures the absolute value of the risk. The 25th percentiles of perceived yields were rescaled between 0 and 1 by subtracting the minimum value from each yield value and dividing the result by the difference between the maximum and minimum values. The higher the 25th percentile, the lower the production risk in terms of the yield value (kg).

4.4.3 Factors explaining production risk

In the next stage of the analysis, the scores for the production risk measures were regressed on finance and socio-economic factors. Ordinary least square (OLS) was used to determine which factors are associated with the production risk measures. The generic form of the OLS model is:

$$y_i = x_i \beta + \varepsilon_i , \quad i = 1, 2, ..., N \text{ (434 farmers)} \qquad (1)$$

where the dependent variable y_i is the risk measure of perceived yields. The independent variables (x_i) were finance factors representing finance obtained from different sources of finance, socio-economic factors and a variable representing farm specialisation.

The finance factors are dummy variables indicating whether the farmers obtained finance from these finance providers. Seven finance providers were included: commercial (*commercial credit*) or subsidised credit (*subsidised credit*) from a bank, commercial credit from a MFI (*mfi*), in-kind finance from a farmers' association (*farmers' association*) or trader (*trader*), flexible payment of inputs to an agricultural input kiosk (*kiosk*), or finance from

other sources of finance (*other*) such as from family and friends. In case a farmer obtained multiple finance from different sources, each finance was counted. For instance, if a farmer obtained finance from a farmers' association, agricultural input kiosk and a friend, then the dummy of one was counted for finance obtained to each of these finance sources i.e. to *farmers' association*, *kiosk* and *other*.

The model also included socio-economic factors: age, education, farming experience, farm size, distance to agricultural input kiosk and infrastructure of roads. Age (*age*) is measured as the age of the farmer (years), education (*education*) is the number of years of formal education of the farmer, and farming experience (*fexp*) is farmer experience in managing their farms (years). Farm size (*fsize*) is measured as the size of area used by the farmers for producing crops. Infrastructure of roads (*infrastructure*) is a dummy variable, with 1 indicating good roads, and distance to agricultural input kiosk (*distance*) is measured as the distance from the farmer's house to the nearest agricultural input kiosk (kilometres). The farm specialisation variable is a dummy variable, for which mango is the reference crop.

The finance variables cover all the sources of finance available to horticultural farmers in Indonesia. Finance from all these sources is expected to reduce production risk on farms because it facilitates access to inputs and technologies. Commercial credit from banks is often for larger loans, which can be used to improve irrigation to boost production (Wossen et al. 2014), which may lead to more robust yields and hence reduce production risk. Subsidised credit from banks is granted mostly for investing in agricultural equipment or renovating old buildings (Brummer and Loy 2000), which may help farmers to reduce the riskiness of production. MFIs provide necessary financial means to obtain both higher quantities and better quality of inputs (Girabi and Mwakaje 2013); credit from MFIs may thus also help to reduce production risk.

With regard to in-kind finance, the provision of inputs to association members (Lamprinopoulou et al. 2011) and to farmers with a contract with traders (Schipmann and Qaim 2011), and the provision of flexible payments for inputs from an agricultural input kiosk all facilitate the access to agricultural inputs, which could decrease a production risk. Farmers need to buy agricultural inputs during the planting and growing periods, while they earn money after crops are harvested (Binam et al. 2004). Bozoglu and Ceyhan (2007) showed that the majority of farmers have a problem of negative cash flow during planting and growing periods. Finance from informal sources, such as family and friends, may help farmers to purchase agricultural inputs during planting and growing periods, which could reduce production risk.

Socio-economic variables that were expected to affect production risk were chosen based on literature. Age is expected to reduce production risk because older farmers focus on improving production, especially after investment and expansion (Zhengfei and Oude Lansink 2006). Education is expected to reduce production risk because more educated farmers use improved technologies more productively on their farms (Wale and Chianu, 2015). Furthermore, more farming experience and larger farm size are also expected to reduce production risk. For instance, Gebrehiwot and van der Veen (2013) found that more experience and larger farms increased the likelihood of adapting to climate change by using crop diversification, which may lead to reduce production risk. The distance from the farmer's house to the agricultural input kiosk and infrastructure of roads are both expected to reduce production risk. Close proximity to the kiosk is expected to reduce production risk because access to input markets is very effective in increasing production (Rachmina et al. 2014). Similarly, good roads are expected to reduce production risk by increasing access to services, such as agricultural input markets (Barrios 2008) and the credit market (Chaudhuri and Cherical 2012).

Before carrying out the regression, all the independent variables, except dummy variables, were standardised to prevent scale effects of the β coefficients. Homoscedasticity was tested using the Breusch-Pagan test and checked for multicollinearity by calculating the variance inflation factors (VIF) for each variable. When the problem of multicollinearity was found, then the problem was corrected by removing variables that have VIF values of more than 10. Rook et al. (1990) suggested that a model is free from multicollinearity problem when the VIF of all variables are below 10.

The definitions and summary statistics of the explanatory variables included in the model are presented in Table 4.1. The table shows that a large percentage (28%) of farmers in the sample obtained finance from other sources, such as family and friends. The average age of the farmers was 47 years, with an average of eight years of formal education; on average, chili farmers were the youngest farmers. The farmers had an average of 24 years of farming experience.

Table 4.1 also shows that finance obtained from different finance sources varies among the groups of farmers. Almost half the mango farmers (45%) obtained finance from other sources, such as family and friends; whereas 39% of mangosteen famers obtained in-kind finance from farmers' associations and 41% of chili farmers obtained finance from traders. A large percentage of red onion famers obtained in-kind finance from agricultural input kiosks (42%).

Table 4.1 Definitions and summary statistics of the explanatory variables

Variables		Variable definition	Mango (n=101)	Mangosteen (n=103)	Chili (n=123)	Red Onion (n=107)	Overall (434)
Bank	Commercial credit	1: obtained commercial credit from bank in 2013	0.18 (0.04)	0.13 (0.03)	0.05 (0.02)	0.11 (0.03)	0.11 (0.02)
	Subsidised credit	1: obtained subsidised credit from bank in 2013	0.06 (0.02)	-	0.35 (0.04)	-	0.11 (0.02)
MFI		1: obtained credit from MFI in 2013	0.04 (0.02)	0.11 (0.03)	0.02 (0.01)	0.08 (0.03)	0.06 (0.01)
Farmers' association		1: obtained in-kind finance from farmers' association in 2013	0.25 (0.04)	0.39 (0.05)	0.15 (0.03)	0.23 (0.04)	0.25 (0.02)
Trader		1: obtained in-kind finance from trader in 2013	0.09 (0.03)	0.05 (0.02)	0.41 (0.04)	0.07 (0.02)	0.17 (0.02)
Kiosk		1: obtained flexible payment of inputs from agricultural input kiosk in 2013	0.08 (0.03)	0.01 (0.01)	0.20 (0.04)	0.42 (0.05)	0.18 (0.02)
Other		1: obtained finance from other finance sources in 2013	0.45 (0.05)	0.14 (0.03)	0.30 (0.04)	0.23 (0.04)	0.28 (0.02)
Age		Age (years)	46 (0.93)	53 (1.11)	41 (0.86)	49 (0.91)	47 (0.52)
Education		Education (years)	9 (0.25)	8 (0.26)	8 (0.25)	7 (0.22)	8 (0.13)
Farming experience		Farming experience (years)	23 (1.13)	31 (1.42)	15 (0.86)	28 (1.17)	24 (0.64)
Farm size		Farm size (hectares)	1.30 (0.30)	0.87 (0.07)	1.20 (0.20)	0.69 (0.15)	1.02 (0.10)
Distance to kiosk		Distance from house to agricultural input kiosk (kilometres)	3.38 (0.29)	3.82 (0.32)	2.07 (0.17)	1.13 (0.11)	2.56 (0.13)
Infrastructure		1: good roads	0.48 (0.05)	0.38 (0.05)	0.25 (0.04)	0.49 (0.05)	0.39 (0.02)

Mean values with standard errors in parentheses.

4.5 Results and discussion

4.5.1 Production risk of horticultural farms

Table 4.2 presents the four measures of production risk for the four groups of farms, grouped by main crop. The CV results show that the yield variability was highest for mangosteen farms (0.28), followed by mango (0.25), chili (0.24) and red onion (0.20). Furthermore, the yield skewness was negative for all crops, which suggests a yield

distribution with an asymmetric tail extending towards lower yields. The skewness ranged between -0.32 (red onion) and -0.02 (mango). Table 4.2 also shows that the kurtosis was less than three for all crops, with values between 2.20 (mango) and 2.86 (chili). This indicates a relatively flat yield distribution. Furthermore, Table 4.2 also shows that the 25th percentiles of perceived yields, which indicate the absolute value of production risk, ranged between 0.21 (mango) and 0.32 (red onion).

Table 4.2 Measures of production risk

Variables	Mango	Mangosteen	Chili	Red Onion
Coefficient of variation	0.25	0.28	0.24	0.20
	(0.01)	(0.02)	(0.01)	(0.01)
Skewness	-0.02	-0.08	-0.10	-0.32
	(0.05)	(0.06)	(0.07)	(0.06)
Kurtosis	2.20	2.32	2.86	2.51
	(0.06)	(0.12)	(0.22)	(0.11)
25th percentile*	0.21	0.27	0.30	0.32
	(0.02)	(0.02)	(0.02)	(0.02)

Mean values with standard errors in parentheses.
* The unit was rescaled on a scale from 0 to 1 by subtracting the minimum value from each yield value and dividing the result by the difference between the maximum and minimum values.

4.5.2 Effect of finance utilisation and socio-economic factors on the production risk of horticultural farms

Table 4.3 shows the outcomes of the regression of production risk measures on socio-economic factors and the factors representing finance utilisation. Results show that the relation between risk and finance utilisation varies across the finance providers and the measures of risk. For instance, finance obtained as commercial credit from banks was associated with a higher 25th percentile, implying a lower production risk in terms of the absolute yield value (kg). This is probably because commercial credit from banks is often for large loans that can be used to improve irrigation to increase production (Wossen et al. 2014). At the same time however, commercial credit was negatively associated with the skewness of the yield distribution, indicating that the yield distribution becomes relatively more left-

skewed. The negative relation with the skewness of the yield distribution suggests that the finance utilisation does not preclude very low yields. For instance, irrigation may help farmers to increase their production, but it does not preclude flooding (Barrios 2008), and hence does not preclude extremely low yields as a result of flooding. The negative association with skewness was also found for finance obtained from farmers' associations. This association might arise if the in-kind finance is not used to benefit the crops. For instance, Gow and Swinnen (2001) found that in-kind finance was used for other purposes, such as selling the inputs, and therefore did not benefit overall farm production.

Table 4.3 Coefficients from the ordinary least square's regression of production risk on the explanatory factors (standard errors in parentheses)

Variables		Coefficient of variation	Skewness	Kurtosis	25th percentile*
Bank	Commercial credit	-0.03 (0.02)	-0.24 [c] (0.13)	0.37 (0.36)	0.06 [c] (3.45)
	Subsidised credit	-0.02 (0.02)	0.03 (0.12)	-0.27 (0.28)	0.04 (3.68)
MFI		-0.01 (0.03)	0.03 (0.16)	0.39 (0.26)	0.04 (3.47)
Farmers' association		0.00 (0.02)	-0.13 [c] (0.07)	-0.15 (0.14)	0.03 (2.38)
Trader		-0.01 (0.02)	-0.12 (0.10)	0.44 (0.29)	-0.00 (3.21)
Kiosk		-0.00 (0.02)	0.17 [c] (0.09)	-0.37 [b] (0.19)	-0.05 [c] (2.86)
Others		0.00 (0.01)	0.05 (0.06)	-0.30 [b] (0.13)	-0.03 (2.17)
Age		0.00 (0.01)	-0.04 (0.05)	0.08 (0.13)	-0.00 (1.45)
Education		-0.01 (0.01)	0.04 (0.03)	-0.07 (0.07)	-0.01 (1.03)
Farming experience		0.01 (0.01)	0.02 (0.05)	0.10 (0.12)	0.00 (1.47)
Farm size		0.01 (0.01)	-0.04 (0.04)	0.40 (0.05)	0.02 [c] (1.28)
Distance to kiosk		0.02 (0.01)	0.05 (0.03)	0.02 (0.08)	-0.03 [c] (1.10)
Infrastructure		-0.01 (0.02)	0.14 [c] (0.08)	0.01 (0.19)	-0.02 (2.20)
Mangosteen		0.01 (0.03)	-0.01 (0.09)	-0.04 (0.17)	0.05 (2.92)
Chili		0.00 (0.02)	-0.04 (0.10)	0.68 [a] (0.23)	0.06 [c] (3.16)
Red Onion		-0.05 [a] (0.02)	-0.31 [c] (0.10)	0.35 [b] (0.16)	0.10 [b] (3.24)
Constant		0.26 (0.02)	-0.07 (0.08)	2.30 (0.13)	0.23 (2.31)

[a] Significant at 1%, [b] 5%, and [c] 10% level.
* The unit was rescaled on a scale from 0 to 1 by subtracting the minimum value from each yield value and dividing the result by the difference between the maximum and minimum values.

Finance utilisation from the agricultural input kiosk decreased the 25th percentile as well as the kurtosis, implying a lower absolute value of yield (kg) and a flatter distribution. This

may reflect that farmers who obtain finance from kiosks are generally those facing lower yields; Wulandari et al. (2016) found that mainly less-educated farmers use this source of finance. At the same time, finance utilisation from the kiosk increased skewness, i.e. the yield distribution becomes relatively less left-skewed. This suggests that very low yields are less likely to occur for these farmers, probably because they have direct access to pesticides. In line with the results for finance obtained from input kiosks, finance from other sources also flattened the yield distribution, as indicated by the lower kurtosis. A possible explanation might be that the farmers applying for other sources are the ones with less experience and therefore they may not be able to fully benefit from the obtained finance.

The results for the farm specialisation dummy variable show that, compared to the other crops, red onion farms have the lowest production risk in terms of CV and 25th percentile (Table 4.4). Nevertheless, the negative skewness still illustrates their high vulnerability for extreme weather events. Adiyoga (2009) showed that crop farmers in Indonesia, especially red onion farmers, experienced a decline in yield growth during the period from 1969 to 2006, probably related to climate change (Widyantara and Yasa 2013).

Table 4.4 Marginal effects from the ordinary least square's regression of production risk on the explanatory factors (standard errors in parentheses)

Variables	Coefficient of variation	Skewness	Kurtosis	25th percentile*
Mango	0.25 [a] (0.01)	-0.04 (0.05)	2.22 [a] (0.07)	0.22 [a] (1.69)
Mangosteen	0.26 [a] (0.03)	-0.05 (0.07)	2.18 [a] (0.15)	0.27 [a] (2.48)
Chili	0.25 [a] (0.02)	-0.09 (0.08)	2.91 [a] (0.23)	0.28 [a] (2.43)
Red Onion	0.20 [a] (0.01)	-0.35 [a] (0.08)	2.57 [a] (0.14)	0.32 [a] (2.68)

[a] Significant at 1% level.

* The unit was rescaled on a scale from 0 to 1 by subtracting the minimum value from each yield value and dividing the result by the difference between the maximum and minimum values

4.6 Conclusions and recommendations

This study analysed the relation between the production risk of horticultural farms and finance utilisation from different finance providers, such as commercial and subsidised credit from banks, commercial credit from MFIs, in-kind finance provided by farmers' associations, in-kind finance from traders, flexible payments of inputs to agricultural input kiosks and other finance sources. Data were collected from 434 Indonesian horticultural farmers who cultivate mango, mangosteen, chili, and red onion. Production risk was measured by the CV, skewness, kurtosis and the 25th percentile.

The results show that the relation between production risk and finance utilisation varies across the finance providers. There is no finance provider for which was found only risk-reducing effects. Depending on the risk measure, some risk-reducing associations were found for commercial credit from banks and flexible payments of inputs to kiosks. The results found no risk-reducing associations for in-kind finance from farmers' associations and finance from other sources. With regard to socio-economic factors, the results found that farmers operating larger farm, close proximity to an agricultural input kiosk and good roads are associated with lower production risk.

The results of this study provide insights to policy makers and finance providers about the role of different sources of finance in reducing production risk. The findings suggest that although finance utilisation does appear to reduce risk reduction, this effect is complex and dependent on who provides the finance and under which conditions. From the findings, the provision of finance from public and private initiatives may need to prioritise commercial credit programmes from banks and flexible payments of inputs to agricultural input kiosks.

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Appendix.

Table 4.A Descriptive statistics of perceived yields

Variables	Mango	Mangosteen	Chili	Red Onion
Minimum	103.43	21.08	10.48	6.40
Maximum	273.41	59.90	23.87	11.94
Mean	175.99	37.94	17.74	9.59
Standard deviation	52.00	12.63	4.27	1.85

The statistic is calculated as the mean and the value is in 1000 kilograms

Chapter 5

Contract Fulfilment of Indonesian Chili Farms. What is the Role of Finance Utilisation from Different Sources of Finance?

Eliana Wulandari[a b], Miranda P. M. Meuwissen[a], Maman H. Karmana[b], and Alfons G. J. M. Oude Lansink[a]

[a] Business Economics, Wageningen University, Wageningen, The Netherlands.

[b] Faculty of Agriculture, University of Padjadjaran, West Java, Indonesia

Submitted for publication

Abstract

Contract farming fosters coordination along food supply chains. The purpose of this study is to analyse the relation between the utilisation of finance from different finance providers and contract fulfilment rates in Indonesian chili farms. Data were collected from 102 chili farmers who had a written contract with a trader. Results show that chili farmers generally had a low contract fulfilment rate (0.57). Factors determining the contract fulfilment rate differed according to the type of finance provider. Contract fulfilment rate was positively associated with the utilisation of in-kind finance from farmers' associations, but negatively associated with the utilisation of subsidised credit from banks and flexible payments of inputs to agricultural input kiosks. The findings suggest that policy makers and value chain actors, when aiming to improve food supply continuity, may stimulate in-kind finance programmes offered by farmers' associations.

Keywords: Horticulture, finance utilisation, contract fulfilment, censored regression

5.1 Introduction

Contract farming has been an important strategy to foster coordination in the supply chain (Guo and Jolly 2008). Advantages of contract farming for farmers include credit provision, access to inputs, a guaranteed market and farm technical assistance (Brambilla and Porto 2011). These advantages improve productivity and income (Sharma 2008). For firms further downstream in the chain, contract farming provides benefits with regard to assurance and stability of raw products (Key and Runsten 1999; Singh 2002).

An increasing number of agribusiness firms and smallholders are involved in contract farming, especially in developing countries such as Indonesia. Previous studies on contract farming in Indonesia have shown that contract farming helps farmers to increase their farm efficiency (Fauziyah 2010) and productivity (Manzilati et al. 2010). Productivity increases because farmers need to work more carefully and follow the planting procedures detailed in the contract. Furthermore, farmers get more useful knowledge from the practice of contract farming compared to solely focussing on extension programmes (Manzilati et al. 2010).

Key and Runsten (1999) have shown that production costs from crops under contractual arrangements are much higher than the costs of traditional crops, since the contract often requires a specific use of inputs and the necessity to involve skilled labour in addition to the farm family. Hence, their study suggested that finance is very important to help contracted farmers to produce products following the requirements in the contract. Furthermore, the majority of farmers face negative cash flows during planting and growing periods (Bozoglu and Ceyhan 2007). Therefore, they need finance to purchase inputs prior to harvesting (Angelucci and Conforti 2010).

Finance can be accessed from different types of finance providers; each provider can be expected to provide specific agricultural inputs and more skilled labour. In general, farmers in

developing countries obtain finance from many types of finance providers. For instance, farmers can apply for credit from banks, moneylenders, relatives, cooperatives (Pham and Lensink 2007; Armendariz and Labie 2011), micro finance institutions (MFIs) (Kaino 2005; Bastin and Matteucci 2007) and various development programmes (Pham and Lensink 2007). In addition to credit, farmers can obtain finance through government subsidies. Subsidies, especially in developing countries, are provided for agricultural inputs, such as fertilizers and seeds, and for interest on credit (Dorward and Chirwa 2011, Wulandari et al. 2015). Despite the important role of finance in fulfilling the contract requirements, to the best of the authors' knowledge, the effect of finance utilisation from different finance sources on contract fulfilment has not yet been studied.

In this context, this study aims to analyse the relation between the utilisation of finance from different finance providers and contract fulfilment rates in Indonesian chili farms. The different finance providers are banks, MFIs, farmers' associations, traders, agricultural input kiosks and so-called 'other sources', such as family and friends. This study focuses on Indonesian chili farms because contract farming plays an important role in this sector (Rudiyanto 2014; Tsurayya and Kartika 2015). Contracts help Indonesian chili farmers to obtain more certainty about prices (Oelviani 2013). Chili contracts specify the price received by the farmer and the local market conditions under which the price can be changed. If the price at the local market is higher than the price written in the contract, then the price is normally adjusted. Apart from prices, contracts typically specify the chili variety and number of chili trees that need to be grown by farmers. Contracts also specify the quantity of chili that has to be delivered by farmers (i.e. the quantity is fixed at 600 grams per tree).

Results of the study provide insight in the role of different finance sources in contract fulfilment; these insights are useful for policy makers, finance providers and supply chain actors in Indonesian agriculture. For policy makers, the results of this study can help in

designing policy to enhance the availability of finance to stimulate food supply continuity. For finance providers and supply chain actors, such as traders, this study provides insight into the effect of their financial provisions on supply chain continuity.

The organisation of the remainder of this paper is as follows. The next section describes the finance sources available to farmers in Indonesia. This is followed by a description of the methods used and an explanation of how the contract fulfilment rate is calculated. The resulting calculations of contract fulfilment rate and estimation results for the effects of finance utilisation on contract fulfilment rate are then described and discussed. The final section provides conclusions and policy implications.

5.2 Sources of finance for farmers in Indonesia

Indonesian farmers can access finance from many different finance sources. Credit is supplied by banks and MFIs, and also others sources, such as friends or relatives (Machmud and Huda 2011). In-kind finance is provided by farmers' associations and traders, whereas agricultural input kiosks offer a scheme of flexible payments for inputs (Wulandari et al. 2015). A full description of the finance sources available to farmers in Indonesia is provided in Wulandari et al. (2015).

Finance from banks. Farmers can access finance from banks by applying for commercial credit. Farmers can also apply for a subsidised credit programme, offered by banks collaborating with the Indonesian government; an example is the programme of micro credit loans (*KUR-Kredit Usaha Rakyat*). The KUR is designed to help farmers obtain credit, especially farmers who do not have any collateral (Agricultural Ministry of Indonesia 2013).

Finance from micro finance institutions. Farmers can also apply for commercial credit offered by MFI. Farmers are required to register as a member of a MFI to obtain credit. Credit from MFI benefits small farmers who cannot obtain credit from banks.

Finance from farmers' associations. Farmers' associations channel government aid for farmers who are members of the farmers' association. The Indonesian government provides the associations with cash aid through the rural agribusiness development programme (*PUAP-Pengembangan Usaha Agribisnis Perdesaan*), which targets farmers' associations as a means to motivate farmers to increase production. The government also provides the associations with seed and fertilizer, farm equipment and subsidies to purchase seed and fertilizer. The associations then distribute the finance obtained from the government to their members. Finance is provided in-kind, i.e. by distributing agricultural inputs to their members. In return, some farmers' associations require their members to sell their products to the farmers' association under the conditions set in the contract between association and members.

Finance from traders. Some traders provide in-kind finance to farmers with a sales contract, which is set by the traders and farmers together. In-kind finance can include seeds, fertilizers and pesticides. The contract specifies the rules for production, the amount of produce to be delivered and prices.

Finance from agricultural input kiosks. Finance is provided by some agricultural input kiosks to farmers by selling inputs, such as seeds, fertilizers and pesticides, for a flexible payment. This means that farmers can pay for the input after purchase; the period for payment is usually between one week and one month after purchase. Some kiosks allow farmers to pay for the inputs after harvesting, as long as the farmers agree to sell the harvest to the kiosk.

Finance from other finance providers. Family and friends serve as *other finance providers*. Informal sources of finance are traditionally important for people in rural areas, as

they supply short-term credit for the urgent demands of farming households, which are usually not met by the formal sector, such as banks and MFIs (Duong and Izumida 2002).

5.3 Research methods

5.3.1 Survey

Questionnaire design. In order to measure the contract fulfilment rate and analyse its relation to finance utilisation and other socio-economic variables, structured questionnaires for farmers were prepared and pre-tested to evaluate consistency and clarity. The questions covered four main areas: (i) socio-economic characteristics of farmers, (ii) finance obtained from different sources during the growing season of 2013, (iii) quantity of chili that farmers agreed to supply in the growing season of 2013 and (iv) quantity of chili that was actually delivered to the trader in the growing season of 2013.

Data collection. The survey was conducted from January 2014 to August 2015. Data were collected in person from farmers who had a written contract with a trader to supply chili in the growing season of 2013. The 102 farmers that were surveyed were selected from the main areas of chili production in Java, i.e. West Java and Central Java. The selection procedure is explained in the following paragraph.

Within Java, study sites were selected based on the importance of chili production. The two provinces in Java with the largest production area were selected as study sites. According to data from the Central Bureau of Statistics in Indonesia (BPS 2013), production of chili occurs mainly in the provinces of West Java and Central Java. Farmers were then randomly selected in each province, based on farm address data obtained from agricultural officers and personal contacts.

5.3.2 Analytical methods

Contract fulfilment was analysed in two different ways. First, a dependent samples t-test was used to test for significant differences between the quantity defined in the contract (termed contract quantity in this paper) and the quantity actually supplied (termed actual quantity in this paper) *within* each group of farmers, e.g. did actual quantity significantly differ from contract quantity for farmers who obtained commercial credit from a bank. Second, an independent samples t-test was used to test for significant differences in the contract and actual quantities *between* farmers with and farmers without finance from a particular source of finance, e.g. did the contract quantity significantly differ between farmers with and farmers without commercial credit from a bank.

Next, the contract fulfilment rate was calculated as the ratio of the quantity of chili (kilograms) actually delivered to the trader to the quantity of chili (kilograms) defined in the contract for the growing season in 2013. The fulfilment rate is therefore between 0 and 1. Next, the contract fulfilment rate was regressed on the variables reflecting the availability of finance from different sources of finance and socio-economic factors, using a censored regression model. Censored regression is a useful tool for obtaining unbiased estimation of a regression model with a limited dependent variable (Tobin 1958), i.e. in this case the rate cannot be less than 0. The generic form of a censored model (Verbeek 2004) is

$$y_i^* = x_i' \beta + \varepsilon_i, \quad \text{i} = 1, 2, ..., \text{N (102 farmers)} \qquad (1)$$

In this study, the dependent variable y_i^* is the contract fulfilment rate of each farmer *i*, the independent variables (x_i') are variables reflecting finance and socio-economic variables, and ε_i is the error term. Finance is measured by dummy variables that take the value 1 if the farmer obtained finance in the growing season of 2013 from a source of finance: commercial

(*commercial credit*) and subsidised credit (*subsidised credit*) from banks, commercial credit from MFIs (*mfi*), in-kind finance from farmers' associations (*farmers' association*) and traders (*trader*), flexible payment of inputs to agricultural input kiosks (*kiosk*), and finance from other sources of finance (*other*), such as from family and friends.

In case a farmer obtained multiple sources of finance, each finance was accounted for. For instance, if a farmer obtained finance from a farmers' association, an agricultural input kiosk and a friend, then the dummy variables *farmers' association*, *kiosk* and *other* took the value 1.

The model also included socio-economic factors: age, education, farming experience, farm size, quality and intercropping. Age (*age*) is measured as the age of the farmer in years. Education (*education*) is measured as the number of years of formal education of farmers, and farming experience (*farming experience*) is the number of years the farmer has experience in chili production. Farm size (*farm size*) is measured as the number of hectares used by the farmers for producing crops. Quality (*quality*) is represented by a dummy variable, which takes the value 1 if the farmer faced at least one rejected delivery during the growing season of 2013 because the quality did not meet the standard required by the contract. Intercropping (*intercropping*) is a dummy variable, which takes the value 1 if the farmer planted any other crops jointly with chili on their farms.

Finance from all sources is expected to increase the contract fulfilment rate because it facilitates better access to inputs and technologies. Finance in the form of commercial and subsidised credit from banks, as well as commercial credit from MFIs, can be used for the following activities: purchase irrigation equipment that can increase production (Wossen et al. 2014), invest in agricultural equipment or renovate old buildings (Brummer and Loy 2000), or obtain more inputs or better quality inputs (Girabi and Mwakaje 2013). All these activities are expected to increase the contract fulfilment rate. In-kind finance from farmers' associations

(Lamprinopoulou et al. 2006) and traders (Schipmann and Qaim 2011), and flexible payment of inputs to agricultural input kiosks may help farmers to obtain inputs that are used throughout the growing season, such as fertilizers and pesticides. Better access to these inputs can increase farm production and subsequently the contract fulfilment rate. Finally, finance from other sources, including family and friends, may help farmers to purchase agricultural inputs during planting and growing periods, as the majority of farmers are faced with negative cash flows during these periods (Bozoglu and Ceyhan 2007).

However, the effect on contract fulfilment of finance utilisation from all sources of finance may be obscured when farmers exhibit opportunistic behaviour and deliberately fail to comply with the contract requirements. This occurs when farmers sell output to the market in situations where the market can give them a higher price (Gow and Swinnen 2001). Furthermore, the effect of in-kind finance utilisation may be obscured when the in-kind finance is not used to benefit crops. Gow and Swinnen (2001) showed that farmers were selling inputs obtained through in-kind finance rather than using them on their land. Similarly, the effect of credit utilisation may be obscured if farmers do not use the credit for their crops. A study in Indonesia found that some farmers used credit for other purposes, such as renovating a house or buying a motorcycle (Rizal and Zulfa 2012).

The socio-economic variables age, education, farming experience and farm size are all expected to increase the contract fulfilment rate. Older farmers are expected to have more financial resources (Lucas and Pabuayon 2011), which may enable them to more easily obtain inputs that can increase production, leading to an increase in contract fulfilment rate. More educated farmers are expected to make better use of new technology (Ghimire and Chi Huang 2016). Lastly, more experienced farmers and those with larger farms have better opportunities to adapt to climate change by using crop diversification (Gebrehiwot and van der Veen 2013), which may lead to increased production and a better contract fulfilment rate.

Before carrying out the regression, all independent variables, except for the dummy variables, were standardised to prevent scale effects of the β coefficients. Standardisation was performed by subtracting the variable-specific mean from each variable, and dividing the result by the standard deviation (UCLA 2015). Homoscedasticity was tested using the Breusch-Pagan test and multicollinearity was checked by calculating the variance inflation factors (VIF) for each variable. Following Rook et al. (1990), no multicollinearity was found in the model as all VIF values were well below 10.

The definitions and summary statistics for all variables included in the model are presented in Table 5.1. The table shows that a large group (52%) of the chili farmers obtained subsidised credit from a bank in 2013. Farmers were, on average, 40 years old with 7 years of formal education. In addition, the farmers had an average of 10 years of farming experience. Table 5.1 also shows that 12% of the respondents had at least one delivery rejected during the growing season of 2013. Furthermore, a large group (69%) of the farmers grew other crops together with chili during the 2013 growing season. Table 1 also shows that the average contract fulfilment rate of chili farms in 2013 was 0.57.

Table 5.1 Definitions and summary statistics of sample respondents (n=102)

Variable		Variable definition	Sample mean
Bank	Commercial credit	1: obtained commercial credit from bank in 2013	0.05
	Subsidised credit	1: obtained subsidised credit from bank in 2013	0.52
MFI		1: obtained commercial credit from MFI in 2013	0.02
Farmers' association		1: obtained in-kind finance from farmers' association in 2013	0.12
Trader		1: obtained in-kind finance from trader in 2013	0.39
Kiosk		1: obtained flexible payment of inputs to agricultural input kiosk in 2013	0.13
Others		1: obtained finance from other finance sources in 2013	0.20
Age		Age (years)	40
Education		Education (years)	7
Farming experience		Chili production experience (years)	10
Farm size		Farm size (hectares)	1.16
Quality		1: had ever faced at least one rejected delivery because of quality issues	0.12
Intercropping		1: grew other crops on their chili farms	0.69
Contract fulfilment rate		Ratio of the quantity (kg) of chili actually delivered to the quantity (kg) of chili defined in the contract for the growing season of 2013	0.57

Source: Authors' calculation

5.4 Results

5.4.1 Contract fulfilment rate

The mean values of the contract and actual quantities are presented in Table 5.2 for farmers who obtained finance from different providers and for farmers who did not obtain finance. Results of the dependent samples t-test show, for all sources of finance, that farmers who did not obtain finance had a significantly lower supply of chili than the quantity specified in the contract. For farmers who obtained finance from a particular source of finance, significant differences between the contract and actual quantities were found for all finance

sources except for finance from MFIs and farmers' associations. This result suggests that finance utilisation from MFIs and farmers' associations helps farmers to fulfil their contract.

Next, an independent samples t-test was used to test whether the contract and actual quantities differed between farmers who obtained and did not obtain finance from a particular source of finance. The results of the independent samples t-test show that farmers who obtained commercial credit from a bank generally had much higher contract quantities than those who did not obtain finance from this source of finance. Farmers who obtained subsidised credit from a bank, in contrast, had lower contract and actual quantities compared to those who did not obtain subsidised credit from a bank.

Table 5.2 Mean values of farmers' contract and actual quantities per group of farmers

Variable [a]		No finance from		Have finance from	
		Contract	Actual supply	Contract	Actual supply
Bank	Commercial credit	4.83 [b, c]	3.53 [b]	16.98 [b, c]	11.26 [b]
	Subsidised credit	8.90 [b, c]	6.68 [b, c]	2.20 [b, c]	1.35 [b, c]
MFI		5.44 [b]	3.93 [b]	4.80	3.15
Farmers' association		5.33 [b]	3.73 [b]	6.15	5.27
Trader		4.29 [b]	3.40 [b]	7.19 [b]	4.71 [b]
Kiosk		5.55 [b]	4.10 [b]	4.54 [b]	2.64 [b]
Others		5.43 [b]	3.89 [b]	5.40 [b]	4.02 [b]

Source: Authors' calculation

[a] Dummy variable representing whether the respondent had obtained finance from the finance provider during 2013; 1 if yes, 0 otherwise.

[b] Statistically significant (5% level) difference in the means within each group of farmers (dependent samples t-test).

[c] Statistically significant (5% level) difference in the means between two groups of farmers (farmers with and without finance from a particular finance source) (independent samples t-test).

The statistic is calculated as the mean and the value is in 1000 kilograms per growing season.

5.4.2 Determinants of contract fulfilment rate

The results of the censored regression of contract fulfilment rate on the variables reflecting finance utilisation and socio-economic factors are presented in Table 5.3. The results show that the relation between contract fulfilment rate and finance utilisation varied

among the finance providers. Subsidised credit negatively associated with the contract fulfilment rate, implying that the contract fulfilment rate was, *ceteris paribus,* lower with finance utilisation from this source. A possible explanation is that subsidised credit might target a special programme for smaller farmers who may have limited chili production experience. These farmers may be less skilled in producing chili according to the quantity and quality requirements specified by the contract. Another explanation is that the subsidised credit may have been used for other activities. Riaz et al. (2012) found that farmers in Pakistan did not use credit for crop purposes but for other activities, such as household needs, construction of a house and other purposes, thereby not benefitting overall farm production.

In line with a priori expectation, finance utilisation from a farmers' association had a positive association with the contract fulfilment rate. This result suggests that the contract fulfilment rate is higher when in-kind finance is obtained from farmers' associations. By being a member of an association, a farmer can benefit from the provision of inputs (Lamprinopoulou et al. 2006), which enable farmers to increase their production and fulfil their contracts. However, finance in the form of flexible payments to an agricultural input kiosk had a negative association with the contract fulfilment rate, which indicates that farmers who obtained finance from the kiosk had, *ceteris paribus,* a lower contract fulfilment rate. This might be because farmers with limited experience in chili production used the kiosk as a last option to obtain finance, i.e. they experienced difficulty in obtaining finance from formal finance sources, such as banks (Supriatna 2009).

Table 5.3 Coefficients from the censored regression of contract fulfilment rate on variables representing finance utilisation and socio-economic factors

Variables		Coefficient	Standard errors
Bank	Commercial credit [d]	-0.002	0.168
	Subsidised credit [d]	-0.191 [c]	0.113
MFI [d]		0.251	0.242
Farmers' association [d]		0.432 [a]	0.149
Trader [d]		-0.101	0.111
Kiosk [d]		-0.264 [b]	0.109
Others [d]		0.067	0.089
Age (years)		-0.024	0.037
Education (years)		0.078 [c]	0.042
Farming experience (years)		0.014	0.038
Farm size (hectares)		-0.044	0.041
Quality [e]		-0.028	0.130
Intercropping [f]		-0.021	0.081
Constant		0.679	0.120

Source: Authors' calculation
[a] Significant at 1%, [b] significant at 5% and [c] significant at 10% level.
[d] Dummy variable representing whether the respondent had obtained finance from the finance provider during 2013; 1 if yes, 0 otherwise.
[e] Dummy variable representing whether the respondent had ever faced at least one rejected delivery because of quality issues; 1 if yes, 0 otherwise.
[f] Dummy variable representing whether the respondent grew other crops on their chili farms; 1 if yes, 0 otherwise

Most socio-economic factors had no statistically significant relation with the contract fulfilment rate. Education was the only exception, which had a positive relation with the contract fulfilment rate. The positive association is consistent with the prior expectation that more educated farmers have better skills to use new technology (Ghimire and Chi Huang 2016), which may increase production and hence the contract fulfilment rate.

5.5 Conclusion and recommendations

This study analysed the relation between the utilisation of finance from different finance providers and contract fulfilment rates in Indonesian chili farms. Sources of finance included in the study were banks, MFIs, farmers' associations, traders, agricultural input kiosks and other finance sources. The results show that the farmers in the sample generally had a low contract fulfilment rate, with an average of 0.57.

The results of the test for differences in the contract and actual quantities *within* the two groups of farmers show that the actual quantity was significantly lower than the contract quantity for farmers who did not obtain finance from a particular source of finance. Moreover, no statistically significant differences were found between contract and actual quantities for farmers who obtained finance from MFIs and farmers' associations. The results of the test for differences *between* the two group of farmers in terms of the contract and actual quantities of chili show that farmers who obtained commercial credit from a bank generally had much higher contract quantities, whereas both contract and actual quantities were lower for farmers who obtained subsidised credit compared to farmers who did not obtain finance from this finance source.

Finance from a farmers' association was positively associated with the contract fulfilment rate. In contrast, subsidised credit from a bank and flexible payments of inputs to an agricultural input kiosk had a negative association with the contract fulfilment rate. Finally, education also had a positive association with the contract fulfilment rate.

The results of this study imply that in-kind finance provided by farmers' associations seems to play an important role in stimulating food supply continuity, thus policies may be necessary to focus on enhancing the availability of finance from this finance provider. Although this study was limited to chili farms, the results can be generalised to other types of

farms in Indonesia that have similar characteristics and operate under similar types of contracts, i.e. farms that produce annual crops under contracts that specify the quantity of crops to be delivered. An example is potato contracts between farmers and traders (Silvia et al. 2015). The results can also be generalised to countries with conditions similar to Indonesia, i.e. countries that have an institutional environment of agricultural value chains similar to that in Indonesia, and that have a similar farm structure as in Indonesia. Examples of countries for which the results may be relevant include countries in South, Southeast and East Asia, and sub-Saharan Africa (Eastwood et al. 2010).

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Chapter 6

General Discussion

6.1 Introduction

The overall objective of this thesis was to analyse the relation between finance utilisation from different finance providers and horticultural business performance in Indonesia. This overall objective was approached through four specific sub-objectives, which were investigated in chapters 2-5. Chapter 2 compared farmer knowledge of the requirements to obtain finance with the actual requirements set by finance providers, and investigated factors that determine farmer knowledge of the requirements. Chapter 3-5 analysed the relation between finance utilisation from different providers, including finance from banks, MFIs, farmers' associations, traders, agricultural input kiosks and so-called "other sources" such as family and friends, and the technical efficiency (Chapter 3), production risk (Chapter 4) and contract fulfilment rate (Chapter 5) of horticultural farms in Indonesia.

This final chapter synthesises the findings of this research and discusses methodological and data issues as well as the policy and business implications. This chapter proceeds in several steps. The next section of this chapter synthesises the findings. Methodological and data issues and policy and business implications are then presented in the third and fourth section, respectively. The final section presents the future research implications and summarises the main conclusions of this thesis.

6.2 Synthesis of results

The main contribution of this thesis is the inclusion of finance obtained from many different finance providers and its relation to horticultural business performance, whereas previous studies focused on only a particular finance provider. The results of this thesis show

that the relation between finance utilisation and horticultural business performance varies across the finance providers.

The outcomes of the four research chapters are summarised in Table 6.1. From the analysis, the utilisation of finance from different finance providers is often found to have different relation in horticultural business performance (Chapter 3-5). The results of Table 6.1 show that there is no single finance provider that stands out in terms of a relation with better performance of horticultural business in Indonesia.

Table 6.1 shows that the relation between finance utilisation and farmer knowledge of finance requirements (Chapter 2), farm technical efficiency (Chapter 3), production risk (Chapter 4) and contract fulfilment (Chapter 5) varies among the finance providers. Although banks and MFIs both provide commercial credit, the relation between commercial credit utilisation and the horticultural business performance differs for banks and MFIs. The utilisation of commercial credit from banks has a positive relation with the technical efficiency of mangosteen and red onion farms, while commercial credit from MFIs negatively associate with the technical efficiency, especially for mangosteen farms (Chapter 3). This could be due to the fact that MFIs providing commercial credit have a special programme for farmers with less capital, as shown in Chapter 3 (Table 3.1). A previous study from Aliero and Ibrahim (2012) showed that a finance programme targeted poor farmers for reducing poverty in rural areas. Furthermore, the utilisation of commercial credit from banks is associated with both lower production risk in terms of absolute value of yield (kg) and higher production risk in terms of yield distribution, i.e. the skewness of the yield (Chapter 4). However, no relation was found between commercial credit from MFIs and production risk (Chapter 4). Subsidised credit from banks has a positive relation with the technical efficiency of mango farms, but a negative relation with the technical efficiency of chili farms (Chapter 3) and the contract fulfilment rate of chili farms (Chapter 5). The negative relation could

indicate that subsidised credit from bank has been used for other activities. A previous study of Riaz et al. (2012) showed that farmers did not use credit for crop purposes but for other activities, such as household needs, construction of a house and other purposes, thereby lowering overall farm production.

With regard to the utilisation of in-kind finance, finance from farmers' associations has a positive association with farmer knowledge of finance requirements (Chapter 2) and the technical efficiency of chili and red onion farms (Chapter 3), whereas in-kind finance from traders shows both a positive association with the efficiency of mangosteen farms and a negative association with the efficiency of chili farms (Chapter 3). The negative association for chili farms might be due to the slow response of traders to requests from farmers for pesticides. A slow response of request for pesticides can cause substantial yield losses because of diseases (Albajes et al. 2002). In-kind finance from farmers' associations is associated with a higher production risk in terms of the skewness of the yield (Chapter 4) and a better contract fulfilment rate of chili farms (Chapter 5). The association with a higher production risk in terms of the skewness of yield might arise if the in-kind finance from farmers' associations is not used to benefit the crops. Previous study of Gow and Swinnen (2001) found that in-kind finance was used for other purposes, i.e. farmers were selling the inputs, and therefore did not benefit overall farm production. Nevertheless, the results of this study did not show any relations with production risk and contract fulfilment for finance utilisation from traders (Chapter 4 and 5).

Finance from the agricultural input kiosks negatively associates with the technical efficiency of mangosteen farms (Chapter 3) and contract fulfilment rate of chili farms (Chapter 5). This might happen when those farmers overused inputs. As explained by Iraizoz et al. (2003), farmers who overuse inputs are less efficient. Also, finance from the kiosks is associated with both lower production risk in terms of the skewness of yield and higher

production risk in terms of the kurtosis of yield and absolute value of yield (kg) (Chapter 4). Finance from other sources, such as family and friends, is associated with a higher production risk in terms of yield distribution, i.e. the kurtosis of yield (Chapter 2-5).

The socio-economic and infrastructure variables are presented in Table 6.2. Most of those variables did not have a statistically significant relation with farmer knowledge of finance requirements, and the performance of horticultural business.

The results of this study did not show any relations between age and knowledge of finance requirements, and the performance of horticultural business in terms of technical efficiency, production risk and contract fulfilment of horticultural farms (Chapter 2-5), while previous studies showed that age has both positive and negative relations with farmer knowledge and performance of horticultural business. For instance, a study from Harrison (2006) found that age significantly increased the knowledge of farmers about financial management practices. Furthermore, Zhengfei and Oude Lansink (2006) found that age has a significant and positive impact on productivity growth since older farmers focus on production improvement especially after investment and expansion. However, other studies suggest that younger farmers are more active in innovating and accepting technologies, therefore can improve farm efficiency (Mar et al. 2013; Ogunbo et al. 2015).

The results of this thesis found mixed relations between education with farmer knowledge and the performance of horticultural business. Education has a positive relation with farmer knowledge of finance requirements of farmers' association and a negative relation with farmer knowledge of finance requirements of the kiosk (Chapter 2). The farmers with less education might focus on looking for finance from the kiosk. This might be because they think they were unlikely to obtain finance from banks and MFIs, and therefore they have more knowledge of finance requirements of the kiosk. Education also has a negative relation with the technical efficiency of mango farms (Chapter 3), which might be, because farming

might be only a side-activity for those farmers as a study of Reardon et al. (2001) showed that higher-educated farmers more often have off-farm jobs. However, education has a positive relation with the contract fulfilment of chili farms (Chapter 5). Interestingly, with regard to farming experience, the results of the thesis show that more-experienced farmers have less knowledge of the finance requirements of banks, MFIs and the kiosks (Chapter 2). Also, more experience is associated with a lower technical efficiency of mango farms (Chapter 3). The negative relation between experience and technical efficiency might be found because respondents in this study may have overestimated the years of their farming experience. This may in particularly hold for farmers that did not work an uninterrupted period on their farms, such as farmers that migrated to the city and decided to return after a few years. These farmers may have included the period of absence in their farming experience. The thesis found that farmers operating larger farms are associated with better farmer knowledge about finance from trader (Chapter 2) and lower production risk in terms of the absolute value of yield (kg) (Chapter 4). A study of Mauro and McLachlan (2008) showed that farmers operating larger farms focus on technology development, which lead to the improvement of knowledge of risk assessment on their farms.

Good infrastructure and closer distance to agricultural input kiosk are associated with a better horticultural business performance in terms of technical efficiency of mango and chili farms (Chapter 3) and a lower production risk in terms of the skewness of yield (Chapter 4). Previous studies also found that good roads increase access to social services, such as farm inputs and credit markets (Barrios 2008; Chaudhuri and Cherical 2012), which may lead to a higher technical efficiency and a less production risk in terms of the skewness of yield.

Table 6.1 The association between finance utilisation from different finance providers and horticultural business performance

Sources of finance		Knowledge of finance requirements	Technical efficiency				Production risk				Contract fulfilment rate
			Mango	Mangosteen	Chili	Red Onion	Coefficient of variation	Skewness	Kurtosis	25th percentile [b]	
Bank	Commercial credit [a]	n.s.	n.s.	+	n.s.	+	n.s.	-	n.s.	+	n.s.
	Subsidised credit [a]		+	n.a.	-	n.a.	n.s.	n.s.	n.s.	n.s.	-
MFI [a]		n.s.	n.s.	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Farmers' association [a]		+	n.s.	n.s.	+	+	n.s.	-	n.s.	n.s.	+
Trader [a]		n.s.	n.s.	+	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Kiosk [a]		n.s.	n.s.	-	n.s.	n.s.	n.s.	+	-	-	-
Other sources [a]		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	n.s.

[a] Dummy variable representing whether the respondent had previously obtained finance from the finance provider; 1 if yes, 0 otherwise.
[b] The unit is rescaled on a scale from 0 to 1.
Notes: n.s. = not significant, n.a. = not applicable

Table 6.2 The association between socio-economic and infrastructure variables and horticultural business performance

Variables	Knowledge of finance requirements	Technical efficiency				Production risk				Contract fulfilment rate
		Mango	Mangosteen	Chili	Red Onion	Coefficient of variation	Skewness	Kurtosis	25th percentile[a]	
Age (years)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Education (years)	+ (Fa), - (Kiosk)	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+
Farming experience (years)	- (Bank, MFI, Kiosk)	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Farm size (hectares)	+ (Trader)	n.a.	n.a.	n.a.	n.a.	n.s.	n.s.	n.s.	+	n.s.
Quality issue [b]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.s.
Intercropping [c]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.s.
Infrastructure [d]	n.a.	+	n.s.	n.s.	n.s.	n.s.	+	n.s.	n.s.	n.s.
Distance from house to agricultural input kiosk (kilometres)	n.a.	n.s.	n.s.	-	n.s.	n.s.	n.s.	n.s.	-	n.s.

[a] The unit is rescaled on a scale from 0 to 1.
[b] Dummy variable representing whether the respondent had ever faced at least one delivery rejection because of quality issue; 1 if yes, 0 otherwise.
[c] Dummy variable representing whether the respondent had other crops in chili farms; 1 if yes, 0 otherwise.
[d] Dummy variable representing the quality of road infrastructure; 1 if yes, 0 otherwise.
Notes: n.s. = not significant, n.a. = not applicable

6.3 Methodological and data issues

Data

Primary data were collected from 43 finance providers (Chapter 2), i.e. banks, MFIs, farmers' associations, traders and agricultural input kiosks. Furthermore, a farmer survey was conducted to collect data from farmers who produce the main crops, i.e. mango, mangosteen, chili and red onion.

In this study, data were collected from finance providers and farmers using a structured questionnaire, which did not require any special knowledge of the farmers on the topic of finance. An earlier study from Rismanto et al. (2013) showed that most farmers in Indonesia could not fill out questionnaires by themselves because they had difficulty to understand the questions in the questionnaire. To anticipate this problem, a trained interviewer assisted each farmer in filling out the questionnaire.

This study used cross-sectional data since the available resources for this research did not allow for collecting panel data. The cross-sectional data only allowed for investigating the *sign* of the relation but not the *causality* of the relation between finance and socio-economic variables and the performance of horticultural business. If this study would have had panel data, the causal relation could have been analysed to gain deeper insight about the impact of finance utilisation from different finance providers on the performance of horticultural business.

Modelling approach

This thesis used quantitative methods throughout Chapter 2-5. In Chapter 2, a gap analysis was used to compare farmer knowledge of the important finance requirements with the important requirements as stated by the finance providers. The non-parametric DEA

approach with output orientation was used in Chapter 3 to measure farm technical efficiency. Literature distinguishes two kinds of approaches to measure technical efficiency, i.e. parametric approaches (Stochastic Frontier Approach) and non-parametric approaches (DEA). A study from Wadud and White (2000) did not find different conclusions from technical efficiency analysis for both approaches. DEA approach was used in this chapter because this approach is suitable for analysing production processes in developing countries, where the availability of data is limited and production technologies are generally less well understood (Brazdik 2006). The SFA approach was not used in this study because SFA requires distributional assumptions of its error term (Hossain et al. 2012), which might not be fulfilled due to data limitations. Production risk in Chapter 4 was measured using various risk indicators, i.e. coefficient of variation, skewness, kurtosis and the 25th percentile. Using various indicators of risk is meaningful because they allow for measuring different dimensions of risk and therefore help to gain a *deeper insight* about the relation between finance utilisation and risk.

Besides DEA, econometric approaches were also used throughout Chapter 2-5 to determine factors associating with horticultural business performance. A censored regression model was employed to determine factors explaining the farmer knowledge and contract fulfilment rate in Chapter 2 and 5 respectively. Censored regression is a useful method for unbiased estimation of a regression model with a limited dependent variable (Tobin 1958). Furthermore, a bootstrap truncated regression was performed in Chapter 3 to determine factors associated with technical efficiency. The bootstrap truncated regression using 2000 replications was selected because this approach accounts for the problem of serial correlation of technical efficiency estimates (Simar and Wilson 2007). The scores of technical efficiency were regressed on finance and socio-economic variables per group of farms specialized in different crops. This was done because each group of specialized farms was assumed to have

a different frontier. However, Chapter 2 and 4 combined all the data from the groups of specialized farms to run the regression since the farm specialization was captured by dummy variables. Finally, an ordinary least squares (OLS) regression was performed in Chapter 4 to determine factors associated with production risk. OLS regression was used in this chapter because the dependent variable in this chapter, i.e. production risk, is not censored or truncated at a particular value.

Some tests were performed before running the regression models in Chapter 2-5. Particularly in Chapter 2, 4 and 5, first, homoscedasticity problem was checked by using the Breusch-Pagan test. For Chapter 3, a bootstrap method using 2000 replications was used as Simar and Wilson (2007) suggested that larger number of replications was performed to achieve more accurate estimation. Multicollinearity was also checked throughout Chapter 2-5 by calculating the Variance Inflation Factors (VIF) for each variable. When the problem of multicollinearity was found, then the problem was corrected by removing variables that have VIF values of more than 10. As Rook et al. (1990) suggested a model is free from multicollinearity problem when the VIF of all variables are below 10.

6.4 Implications of the study

Policy implications

The results of this thesis suggest that the performance of horticultural business in Indonesia relates to the infrastructure and financial aspects. With regard to the infrastructure aspect, good roads and agricultural inputs access help horticultural farmers to improve their farm performance. Good roads and closer distance to agricultural input kiosk associate with a better performance of horticultural business in terms of technical efficiency of at least one

crop (Chapter 3) and a lower production risk (Chapter 4). Therefore, the results of this thesis suggest policy makers to provide better access to infrastructure.

With regards to experience with specific finance provider, findings from Chapter 3 show that commercial credit utilisation from banks relates to an efficiency improvement of mangosteen and red onion farms. In addition to findings from Chapter 3, Chapter 4 provided evidence that finance utilisation from this source is associated with a lower production risk. Therefore, this study recommends that the provision of finance from public and private initiatives may need to prioritise commercial credit programmes from banks.

Knowing the current status of the farmer knowledge about the finance requirements provides insight for policy makers and finance providers in designing strategies to enhance the availability of finance. The results of this thesis show that farmers have relatively little knowledge of finance requirements that are important for each type of finance provider (Chapter 2). Hence, awareness campaigns are needed to increase farmer knowledge of the diversity of requirements among the finance providers. Farmers awareness about finance requirements from different finance providers is expected to improve farmer knowledge about finance requirements, thereby it may enhance farmers' opportunity to obtain finance from different sources of finance.

In general, this thesis suggests the need to enhance the availability of finance from different finance providers. The majority of farmers in Indonesia do not have enough money to purchase agricultural inputs such as fertilizers and pesticides during planting and growing periods (Purnaningsih 2007; Achmad et al. 2012; Agustyasari et al. 2013), therefore the availability of finance may help farmers especially during these periods. In addition to the need of finance to overcome the issue of lack of money during planting and growing periods, some findings of this thesis show that finance utilisation has a positive relation with a higher performance of horticultural business in Indonesia. For instance, commercial credit utilisation

from banks has a positive relation with the technical efficiency of mangosteen and red onion farms (Chapter 3). Also, subsidised credit from banks has a positive relation with the technical efficiency of mango farms (Chapter 3). Therefore, this raises the need to bring a financial system that can serve the needs for farmers especially for farmers operating smaller farms (Chapter 2 and 5) in Indonesia. The results of this thesis show that farmers operating larger farms have more knowledge about finance especially from the traders (Chapter 2), which may enhance farmers' opportunity to obtain finance from the traders. Furthermore, chili farmers operating larger farms have a positive relation with contract fulfilment rate (Chapter 5). This means that farmers operating smaller farms need to obtain finance from a financial institution providing a financial programme that can serve the needs of farmers operating smaller farms, for instance by allowing the farmers to pay back their loans after harvesting. An example of such a financial programme is an inclusive finance programme. Inclusive finance has become a priority for policy makers in many countries as this programme aims to provide easier access to financial services and more reasonable cost of the services (Shehu 2012).

This study was conducted in Indonesia. However, the results can be generalized to countries with similar conditions as Indonesia, i.e. countries that have an institutional environment of agricultural value chains and finance providers similar to that in Indonesia, and with a similar farm structure as Indonesia such as countries in South, Southeast and East Asia, and sub-Saharan Africa countries (Eastwood et al. 2010).

Business implications

Throughout Chapter 2-5, the results show that finance utilisation from different finance providers plays a different role in technical efficiency, production risk and contract fulfilment of Indonesian horticultural farms. Different requirements are applied to obtain finance from

each finance provider (Chapter 2). Some finance providers do not apply strict requirements such as collateral and business plan, so farmers who are starting their horticultural business can go to those finance providers, such as traders and agricultural input kiosks. Also, farmers who have liquidity constraints during planting and growing periods can go to agricultural input kiosks, which help farmers by offering more flexibility of input payments. This may help farmers to have a lower production risk (Chapter 4).

Furthermore, farmers who are eligible to obtain commercial credit from bank can go to this finance provider since commercial credit from bank helps farmers to have a higher technical efficiency (especially for the case of mangosteen and red onion farms) (Chapter 3) and a lower production risk in terms of the absolute value of yield (kg) (Chapter 4).

The business implications also extend to traders and farmers who have sales contracts with traders. Findings from Chapter 5 show that in-kind finance utilisation from farmers' association relates to a higher contract fulfilment. Therefore, farmers can go to a farmers' association to become a member of the association in order to be able to obtain in-kind finance from the association since finance obtained from this source seems a promising pathway to have a higher contract performance, which in turn benefits the continuity in the supply chain.

6.5 Future research

Further research can be performed to enhance the conclusions drawn from this thesis. For the long-term impacts of finance utilisation on horticultural business performance, further research about this topic is important especially for policy makers, finance providers and agricultural actors such as farmers and traders. Therefore, longitudinal research to obtain panel data can be useful to analyse the impact of finance utilisation on the horticultural

business performance over a period of years. A fixed effects regression model can control the observed and unobserved factors that are constant over time (Gertler et al. 2011). However, as Gertler et al. show, there may still be endogeneity due to unobservable factors that affect the outcomes of the farmers with and without finance utilisation differently. The endogeneity can be checked using the Hausman test. In case of endogeneity, additional instrumental variables need to be estimated with 2SLS or GMM (Verbeek 2004).

This thesis did not collect information about the amount and duration of finance obtained by farmers because this was beyond the scope of the research. However, a specific study about the amount and duration of finance obtained by farmers can be useful to figure out whether more finance is needed to improve farm performance. Hence, future research should collaborate with finance providers, which can provide information about the amount and duration of finance distributed to farmers. This could provide a *deeper* understanding about the impacts of finance programmes on farm performance, i.e. farm technical efficiency, production risk and contract fulfilment.

6.6 Main conclusions

The main conclusions of this thesis are:

- Farmers have relatively little knowledge of the different finance requirements, which are important for each type of finance provider; the percentage of farmers having knowledge of requirements ranges from 17% for knowledge of the requirements of the kiosks to 63% with respect to the requirements of banks (Chapter 2).
- Commercial credit utilisation from banks is associated with a higher technical efficiency of mangosteen and red onion farms (Chapter 3), a higher production risk in terms of the

skewness of the yield, and a lower production risk in terms of the absolute value of yield (kg) (Chapter 4).

- Commercial credit utilisation from MFIs is associated with a lower technical efficiency of mangosteen farms (Chapter 3).
- Subsidised credit utilisation from banks is associated with a higher technical efficiency of mango farms, but a lower technical efficiency of chili farms (Chapter 3) and a lower contract fulfilment rate of chili farms (Chapter 5).
- Utilisation of in-kind finance obtained through farmers' associations is associated with better knowledge of finance requirements of the farmers' association (Chapter 2), a higher technical efficiency of chili and red onion farms (Chapter 3), a higher production risk in terms of the skewness of yield (Chapter 4), and a better contract fulfilment rate of chili farms (Chapter 5).
- Utilisation of in-kind finance obtained through traders is associated with a higher technical efficiency of mangosteen farms, but a lower technical efficiency of chili farms (Chapter 3).
- Flexible payments of inputs to agricultural input kiosks is associated with a lower technical efficiency of mangosteen farms (Chapter 3), a lower production risk in terms of the skewness of the yield, and a higher production risk in terms of the kurtosis of the yield and the absolute value of yield (Chapter 4), and also with a lower contract fulfilment rate of chili farms (Chapter 5).
- Utilisation of finance from so-called "other sources" including family and friends is associated with a higher production risk in terms of the kurtosis of the yield (Chapter 4).
- Farming experience is associated with a lower knowledge of finance requirements of bank, MFI and the kiosk (Chapter 2), and a lower technical efficiency of mango farms (Chapter 3).

- Higher contract fulfilment of chili farms is associated with a higher educational background of farmers (Chapter 5).
- Age is not associated with farmer knowledge about finance requirements, technical efficiency, production risk and contract fulfilment (Chapter 2-5).
- Farmers operating larger farms are associated with more knowledge about finance requirements of trader (Chapter 2) and a lower production risk in terms of the absolute value of yield (kg) (Chapter 4).
- Good roads and closer proximity to agricultural input kiosk are associated with a higher technical efficiency of horticulture especially for mango and chili farms (Chapter 3) and a lower production risk in terms of the skewness of yield (Chapter 5).

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Summary

Finance for farmers has recently been a concern for policy makers, especially in developing countries. Finance is important for farmers to purchase agricultural inputs such as seeds, fertilizers, insecticides and fungicides, to purchase machinery and to pay for hired labour, which can improve farm performance. Farmers in Indonesia can obtain finance from various finance providers, i.e. banks, MFIs, farmers' associations, traders, agricultural input kiosks and so-called "other sources" such as family and friends. The existing literature focused mostly on finance obtained from a particular finance source, whereas finance can be obtained from different types of finance providers. In the light of the foregoing, the overall objective of this thesis was to analyse the relation between finance utilisation from different finance providers and horticultural business performance in Indonesia.

Chapter 2 compared farmer knowledge of the requirements to obtain finance with the actual requirements set by finance providers, and investigated factors that determine farmer knowledge of the requirements. A censored regression was used to investigate factors determining farmer knowledge of the finance requirements. Results show that farmers generally have little knowledge of the finance requirements, which are important to each type of finance provider. Furthermore, the results of this chapter did not show any significant associations between farmer knowledge of finance requirements and experience with specific finance provider, except for experience with in-kind finance from farmers' associations, which has a significant and positive association with farmer knowledge of finance requirements. The results further show mixed relations between education with farmer knowledge of requirements for obtaining finance. With regard to socio-economic factors, education has both a positive relation with farmer knowledge of finance requirements of farmers' association and a negative relation with farmer knowledge of finance requirements

of the kiosk. Moreover, farmers with more farming experience have less knowledge of the finance requirements of banks, MFIs and the kiosks. Farmers operating larger farms are associated with better farmer knowledge about finance from trader.

Chapter 3 analysed the relation between finance utilisation from different finance providers including finance from banks, MFIs, farmers' associations, traders, agricultural input kiosks and so-called "other sources" such as family and friends, and the technical efficiency of horticultural farms. An output-oriented Data Envelopment Analysis approach was used to estimate the technical efficiency of selected farms. Afterwards, a bootstrap truncated regression was used to estimate the relation with finance and socio-economic factors. Results show that commercial credit utilisation from banks has a positive relation with the technical efficiency of mangosteen and red onion farms, while commercial credit from MFIs negatively associate with the technical efficiency of mangosteen farms. Subsidised credit utilisation from banks has a positive relation with the technical efficiency of mango farms, but a negative relation with the technical efficiency of chili farms. Furthermore, in-kind finance utilisation from farmers' associations has a positive association with the technical efficiency of chili and red onion farms, whereas in-kind finance from traders shows a positive association with the efficiency of mangosteen farms and a negative association with the efficiency of red onion farms. Finance from the agricultural input kiosks negatively associates with the technical efficiency of mangosteen farms. With regard to socio-economic factors, good roads and closer distance to agricultural input kiosk have a positive association with the technical efficiency of mango and chili farms. However, education has a negative relation with the technical efficiency of mango farms. Also, more farming experience is associated with a lower technical efficiency of mango farms.

Chapter 4 analysed the relation between finance utilisation from different finance providers and production risk. This chapter elicits perceived yields that can be obtained in the

next five years given the current use of inputs, finance obtained from a particular finance provider, disease pressure and physical growth conditions. Production risk was measured using various measures of risk. An ordinary least squares regression was used to estimate the relation between production risk and experience with specific finance provider and socio-economics factors. Results show that commercial credit utilisation from banks is associated with both lower production risk in terms of absolute value of yield and higher production risk in terms of yield distribution, i.e. the skewness of yield. In-kind finance utilisation from farmers' associations is associated with a higher production risk in terms of the skewness of the yield. Also, finance utilisation from the kiosks is associated with both lower production risk in terms of the skewness of the yield and higher production risk in terms of the kurtosis of yield and absolute value of yield. Good roads and closer distance to agricultural input kiosk are associated with a lower production risk in terms of the skewness of yield and the absolute value of yield, respectively. The results also show that farmers operating with larger farms are associated with a lower production risk in terms of the absolute value of yield (kg).

Chapter 5 analysed the relation between finance utilisation and chili supply continuity as reflected by the rates of contract fulfilment. A censored regression was used to investigate the relation of different factors with contract fulfilment. Results show that subsidised credit from banks has a negative relation with the contract fulfilment rate of chili farms. However, in-kind finance from farmers' associations is associated with a better contract fulfilment rate of chili farms. Finance from the agricultural input kiosks has a negative association with the contract fulfilment rate. Most of the socio-economic variables do not have a statistically significant relation with contract fulfilment of chili farms. The exception is for education, which has a positive relation with the contract fulfilment of chili farms.

Finally, Chapter 6 synthesises the results of the research chapters and discusses the data and methods used in this thesis. The chapter provides policy and business implications,

suggests future research and draws the main conclusions. The main conclusions are as follows:

- Farmers have relatively little knowledge of the different finance requirements, which are important for each type of finance provider; the percentage farmers having knowledge of requirements ranges from 17% for knowledge of the requirements of the kiosks to 63% with respect to the requirements of banks (Chapter 2).
- Commercial credit utilisation from banks is associated with a higher technical efficiency of mangosteen and red onion farms (Chapter 3), a higher production risk in terms of the skewness of the yield, and a lower production risk in terms of the absolute value of yield (kg) (Chapter 4).
- Commercial credit utilisation from MFIs is associated with a lower technical efficiency of mangosteen farms (Chapter 3).
- Subsidised credit utilisation from banks is associated with a higher technical efficiency of mango farms, but a lower technical efficiency of chili farms (Chapter 3) and a lower contract fulfilment rate of chili farms (Chapter 5).
- Utilisation of in-kind finance obtained through farmers' associations is associated with better knowledge of finance requirements of the farmers' association (Chapter 2), a higher technical efficiency of chili and red onion farms (Chapter 3), a higher production risk in terms of the skewness of yield (Chapter 4), and a better contract fulfilment rate of chili farms (Chapter 5).
- Utilisation of in-kind finance obtained through traders is associated with a higher technical efficiency of mangosteen farms, but a lower technical efficiency of chili farms (Chapter 3).
- Flexible payments of inputs to agricultural input kiosks is associated with a lower technical efficiency of mangosteen farms (Chapter 3), a lower production risk in terms

of the skewness of the yield, and a higher production risk in terms of the kurtosis of the yield and the absolute value of yield (Chapter 4), and also with a lower contract fulfilment rate of chili farms (Chapter 5).

- Utilisation of finance from so-called "other sources" including family and friends is associated with a higher production risk in terms of the kurtosis of yield (Chapter 4).
- Farming experience is associated with a lower knowledge of finance requirements of bank, MFI and the kiosk (Chapter 2), and a lower technical efficiency of mango farms (Chapter 3).
- Higher contract fulfilment of chili farms is associated with a higher educational background of farmers (Chapter 5).
- Age is not associated with farmer knowledge about finance requirements, technical efficiency, production risk and contract fulfilment (Chapter 2-5).
- Farmers operating larger farms are associated with more knowledge about finance requirements of trader (Chapter 2) and a lower production risk in terms of the absolute value of yield (kg) (Chapter 4).
- Good roads and closer proximity to agricultural input kiosk are associated with a higher technical efficiency of horticulture especially for mango and chili farms (Chapter 3) and a lower production risk in terms of the skewness of yield (Chapter 5).

About the author

Eliana Wulandari was born on March 19, 1980 in Medan, North Sumatera, Indonesia. In 2003, she finished her bachelor degree in Agronomy from Bogor Agricultural University in Indonesia. In 2004, she finished her master's degree in Agribusiness Management from Bogor Agricultural University in Indonesia. In 2012, she was awarded the Netherlands Fellowship Programme for a PhD programme at Wageningen School of Social Sciences, Wageningen University, the Netherlands. Since 2008, she has been working as a lecturer in Department of Agricultural Socio-Economics, Faculty of Agriculture, Padjadjaran University in Indonesia.

Eliana Wulandari
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Advanced Microeconomics (ECH 32306)	Wageningen University	2012	6
Organisation of the Agribusiness (BEC 31306)	Wageningen University	2012	6
Cooperatives and Producer Organisations (BEC 53306)	Wageningen University	2013	6
Advanced Agricultural Business Economics (BEC 30306)	Wageningen University	2013	6
Advanced Econometrics (AEP 60306)	Wageningen University	2013	6
B) General research related competences			
Introduction course	WASS	2012	1
PhD meetings	Wageningen University	2012-2016	1.5
Writing PhD research proposal	BEC, Wageningen University	2012-2013	6
'Determining Important Factors Influencing Access to Finance: The Perspective of Finance Providers in West Java'	European Association of Agricultural Economists (EAAE), Ljubljana, Slovenia	2014	1
'Comparing Farmers Knowledge about Finance with The Requirements set by Finance Providers: an In-depth Assessment for Horticulture in Indonesia'	International Association of Agricultural Economists (IAAE), Milan, Italy	2015	1
'The Role of Access to Finance from Different Finance Providers on Production Risks of Horticulture in Indonesia'	WASS PhD Day	2016	1
C) Career related competences/personal development			
Information Literacy including EndNote Introduction	WGS	2012	0.6
Techniques for Writing and Presenting a Scientific Paper	WGS	2012	1.2
Scientific Writing	WGS	2013	1.8
Parametric Efficiency and Productivity Analysis	WASS	2013	3
Dynamic Efficiency and Productivity Analysis	WASS	2013	3
Total			**51.1**

*One credit according to ECTS is on average equivalent to 28 hours of study load

Acknowledgments

I would like to express my grateful acknowledgements to the contribution and support from many individuals for the completion of this PhD thesis. First and foremost, I would like to express my deepest gratitude to my promotor Prof. Dr Alfons Oude Lansink. Prof Alfons, I am very lucky having a promotor like you, as you are the most straightforward person I have ever met. Thank you for all the support, guidance and for encouraging me to think and write critically. My grateful acknowledgements also go to my co-promotor and supervisor, Dr Miranda Meuwissen, for your guidance and supervision of my research. Thank you for all your support and positive thinking during my PhD programme. I would like to extend my grateful acknowledgements to my local supervisor, Prof. Maman H. Karmana. Thank you for your supervision and trust in me for finishing my PhD programme.

I would like to thank my colleague in Department of Agricultural Socio-Economics, Padjadjaran University, Dr. Ir. Tommy Perdana who helped me a lot in providing information about my respondents in this PhD thesis. I sincerely thank Nurul and Jamal, the paranymphs of my PhD defence. Thank you very much for your help, especially in the process of submitting and distributing my PhD thesis. I also would like to thank all my colleagues at the Business Economics group. Ngoc, Frazen, Mas Waldi, Pak Dikky, Gumi, Laya, Felix, Niels, Jaap, Eva, Daniel, Simon, and Lien: thanks for the very enjoyable time and unforgettable moments during PhD meetings, coffee breaks, BBQs, BEC dinner and outings, and other meetings we had. I further thank my room mates Tsion and Beshir for sharing many talks and jokes during the office hours. To Mrs. Anne Houwers, Mrs. Jeanette, Ilona, and Natasja, thank you very much for all the administrative support. Also many thanks to all my friends from Indonesia for friendship, for being helpful, and for having great moments when I was in Wageningen.

I am deeply grateful to my family for all their support and love. Mas Irfan, thank you so much for your prayers, help and patience to be with me during my PhD programme. My father and mother, thank you so much for your prayers and help especially for taking the best care of my children. To my lovely children, Aisyah and Habibi, thank you so much for your prayers and for cheering me up especially during my PhD completion.

Colophon

The research described in this thesis was financially supported by the Netherlands Fellowship Programme (Nuffic) under grant number CF8561/2012.

Cover design by : Eliana Wulandari and Proefschriftmaken.nl || Digiforce Vianen
Printed by : Proefschriftmaken.nl || Digiforce Vianen